Recent Literature on Lichens and Mattick's Card Index

Results of 6/24/01 web search at:

Culberson, W.L., Egan, R.S. & Esslinger, T.L. 2001. Recent literature on lichens. http://www.nhm.uio.no/botanisk/bot-mus/lav/sok_rll.htm. [Presented on the Web by E. Timdal. First posted 1997.04.14, latest update 2001.04.27.]

METALS

Search criteria (word match - sorted on author):
Data set(s): RLL + Mattick + Supplement
Text string in title, keywords, or abstract: metals
Period: 1875 - 2001

- Addison, PA/ Puckett, KJ 1980: Deposition of atmospheric pollutants as measured by lichen element content in the Athabasca oil sands area. - *Canadian Journal of Botany* **58**: 2323-2334. [RLL# 109-1]
CANADA/ VANADIUM/ AIR POLLUTION/ METALS/ TITANIUM/ ALUMINUM/ POTASSIUM/ SULFUR
5 figures. 3 tables. [The accumulation of aluminum, potassium, sulphur, titanium and vanadium in three lichens species "... was related to both gaseous and particulate emissions from industrial sources and to a localized windblown dust component. Visible changes in the thallus condition appeared to be related to the element concentrations."]

- Alstrup, V/ Hansen, ES 1977: Three species of lichens tolerant of high concentrations of copper. - *Okios* **29**: 290-293. [RLL# 100]
COPPER/ HEAVY METALS/ UMBILICARIA/ LECANORA/ ALECTORIA/ ECOLOGY
[Umbilicaria lyngei, Alectoria pubescens, Lecanora polytropa studied.]

- Antonelli, ML/ Ercole, P/ Campanella, L 1998: Studies about the adsorption on lichen Evernia prunastri by enthalpimetric measurements. - *Talanta* **45**: 1039-1047. [RLL# 172]
EVERNIA/ HEAVY METALS/ METAL UPTAKE
4 fig. 2 tab.

- Antonovics, J/ Bradshaw, AD/ Turner, RG 1971: Heavy metal tolerance in plants. - *Avdanc. Ecol. Res.* **7**: 1-85. [RLL# 82]
HEAVY METALS/ POLLUTION/ ADAPTATIONS
5 tab. [Includes bryophytes (pp. 11, 14) and lichens p. 14).]

- Aptroot, A/ van den Boom, PPG 1998: Pyrenocollema chlorococcum, a new species with a chlorococcoid photobiont from zinc-contaminated soils and wood. - *Cryptogamie, Bryologie-Lichénologie* **19(2-3)**: 193-196. [RLL# 172]
CHLOROCOCCALES/ METAL POLLUTION/ PHOTOBIONT/ PYRENOCOLLEMA/ ZINC
2 fig. [New: Pyrenocollema chloroccum sp. nov. (The Netherlands, Belgium). Previously described species in this genus all contain cyanobacteria.]
- Bacci, E/ Gaggi, C/ Pecetti, G/ Lanzillotti, E/ Ferrozzi, S/ Loppi, S 2000: Mapping trace contaminant emissions from a municipal waste incinerator. - *Toxicological and Environmental Chemistry* **78**: 55-71. [RLL# 181]
AIR POLLUTION/ EMISSIONS/ INCINERATOR/ ITALY/ MAPPING/ TRACE METALS
11 fig. 11 tab.

- Backor, M/ Hudák, J/ Backorova, M 1998: Comparison between growth responses of autotrophic and heterotrophic populations of lichen photobiont Trebouxia irregularis (Chlorophyta) on Cu, Hg and Cd chlorides treatment [Wirkungen der Schwermetallchloride (Cu, Hg und Cd) auf das Wachstum autotropher und heterotropher Populationen des Photobionten Trebouxia irregularis (Chlorophyta)]. - *Phyton [Austria]* **38(2)**: 239-250. [RLL# 174]
AIR POLLUTION/ CD/ CHLORIDE/ CU/ HEAVY METALS/ MERCURY/ PHOTOBIONT/ TREBOUXIA
7 fig.

- Bargagli, R 1989: Determination of metal deposition patterns by epiphytic lichens. - *Toxicological and Environmental Chemistry* **18**: 249-256. [RLL# 140]
METAL DEPOSITION/ EPIPHYTES/ HEAVY METALS/ BIOMONITORING/ ACCUMULATION
1 table. 1 figure. ["Evidence is given of a patterned metal accumulation in lichens and for the foliose species, the analysis of

the outermost edge of the thallus is suggested. Moreover, the raw concentrations of metals must be normalized to the earth's crustal abundance, as lichens entrap atmospheric particulates which are mostly constituted by soil and rock dust suspended by wind."]

- Bargagli, R 1993: Plant Leaves and Lichens as Biomonitors of Natural or Anthropogenic Emissions of Mercury. - *In:* Markert, B (ed.): *Plants as Biomonitors. Indicators for Heavy Metals in the Terrestrial Environment*. . VCH, Weinheim pp. 461-484. [RLL# 156]
BIOINDICATORS/ BIOMONITORING/ HEAVY METALS/ MERCURY/ POLLUTION
6 fig. 2 tab.

- Bargagli, R/ Barghigiani, C/ Siegel, BZ/ Siegel, SM 1989: Accumulation of mercury and other metals by the lichen, Parmelia sulcata, at an Italian minesite and a volcanic area. - *Water, Air, and Soil Pollution* **45(3-4)**: 315-327. [RLL# 139]
HEAVY METALS/ ACCUMULATION/ ITALY/ MINING/ MERCURY/ ZINC/ AIR POLLUTION
5 figures. 6 tables. ["No significant pattern could be assigned to the other metals studied, nor was there evidence of a regular relationship between soil content and plant content except in the case of Hg. The data also suggests that high Zn values in the lichen of Mt. Amiata may be based on long range atmospheric transport. Finally, we conclude that widely separated populations of the same species can display biogeochemical differences that are best explained on an eco-physiological basis."]

- Bargagli, R/ Barghigiani, C/ Siegel, BZ/ Siegel, SM 1991: Trace metal anomalies in surface soils and vegetation on two active island volcanoes: Stromboli and Vulcano (Italy). - *Science of the Total Environment* **102**: 209-222. [RLL# 181]
ELEMENT ANALYSIS/ ITALY/ TRACE METALS/ VOLCANOES/ VULCANISM
6 fig. 4 tab.

- Bargagli, R/ D'Amato, ML/ Iosco, FP 1987: Lichen biomonitoring of metals in the San Rossore Park: contrast with previous pine needle data. - *Environmental Monitoring and Assessment* **9**: 285-294. [RLL# 140]
AIR POLLUTION/ BIOMONITORING/ EPIPHYTES/ PARMELIA/ ITALY/ TRACE ELEMENTS/ HEAVY METALS
5 figures. [Study conducted on samples of Parmelia caperata from coastal Italy. "Metal deposition in the park was found to be low throughout the year. A slight increase in Cu, Co, and Ni occurred at the east-southeastern edge of the park adjacent to Pisa. Lichens were not affected by the sea-spray which has destroyed the coastal vegetation." The lichens are not reliable indicators of sea-spray-borne contamination.]

- Bargagli, R/ Gasparo, D/ Lazzarin, A/ Lazzarin, G/ Olivieri, S/ Tretiach, M 1991: Lichens as indicators and monitors of atmospheric pollutants in NE Italy: preliminary data on the integrated testing system. - *Botanika Chronika* **10**: 977-982. [RLL# 174]
AIR POLLUTION/ BIOINDICATION/ BIOMONITORING/ ITALY/ METALS
3 fig.

- Bargagli, R/ Iosco, FP/ Barghigiani, C 1987: Assessment of mercury dispersal in an abandoned mining area by soil and lichen analysis. - *Water, Air, and Soil Pollution* **36(1-2)**: 219-225. [RLL# 139]
POLLUTION/ MERCURY/ PARMELIA/ ITALY/ CINNABAR/ ALUMINUM/ HEAVY METALS
5 figures. [Study conducted on Parmelia sulcata in Italy. "Metal concentrations in soil and in lichen are significantly related and decrease at increasing distances from the zone most affected by mine spoil and by air which is still vented from mine shafts. On the basis of these results and of Al analysis, it seems likely that anomalous Hg content of Mt. Amiata lichens is mainly due to the out-gassing of volatile Hg from soil, from vegetation and, in the most heavily polluted zone, to the air from mine shafts."]

- Bargagli, R/ Iosco, FP/ D'Amato, ML 1987: Zonation of trace metal accumulation in three species of epiphytic lichens belonging to the genus Parmelia. - *Cryptogamie, Bryologie et Lichenologie* **8(4)**: 331-337. [RLL# 134]
PARMELIA/ TRACE METALS/ ACCUMULATION/ EPIPHYTES/ ZONATION/ LOCALIZATION/ ITALY/ POLLUTION
2 tables. 1 figure. [Hg, Pb, Zn, Cu, Cr, Mn, Fe, Se and Al were analyzed in Parmelia caperata, P. saxatilis and P. sulcata near Siena, Italy. "In each environment the three species accumulate comparable amounts of the trace elements. In the inner zone of the thalli average concentrations of all elements are always higher."]

- Bartók, K 1988: Heavy metal distribution in several lichen species in a polluted area. - *Revue Roumaine de Biologie, Série de Biologie Végétal* **33(2)**: 127-134. [RLL#]

AIR POLLUTION/ HEAVY METALS/ TRANSPLANTS
6 fig. [Transplant study using Parmelia conspersa, Lecanora subfusca, Peltigera canina.]

- Bartók, K/ Nicoara, A/ Bercea, V/ Osváth, T 1992: Biological responses in the lichen Xanthoria parietina transplanted in biomonitoring stations. - *Revue Roumaine de Biologie, Série de Biologie Végétal* **37(2)**: 135-142. [RLL# 151]
AIR POLLUTION/ BIOMONITORING/ ROMANIA/ TRANSPLANTS
4 fig. 1 tab. [Study of chlorophyll content, respiration, and metals content in lichens transplanted around polluting sources.]

- Beck, JN/ Ramelow, GJ 1990: Use of lichen biomass to monitor dissolved metals in natural waters. - *Bulletin of Environmental Contamination and Toxicology* **44(2)**: 302-308. [RLL# 141]
BIOMASS/ HEAVY METALS/ LOUISIANA/ BIOMONITORING/ AQUATIC POLLUTION
8 figures. [Study conducted in SW Louisiana using lichen material exposed for a two week period. The technique seems to have potential as a biomonitoring procedure.]

- Beckett, PJ/ Boileau, LJR/ Padovan, D/ Richardson, DHS 1982: Lichens and mosses as monitors of industrial activity associated with uranium mining in northern Ontario, Canada--part 2: distance dependent uranium and lead accumulation patterns. - *Environmental Pollution, Series B* **4**: 91-107. [RLL# 119-9]
URANIUM/ ONTARIO/ CANADA/ LEAD/ ACCUMULATION/ AIR POLLUTION/ HEAVY METALS/ ECOLOGY
2 tables. 8 figures. ["The variation in concentration (C(d)) of uranium and lead in lichens and mosses with distance (d) from emission sources associated with the mining and milling of uranium conformed to the equation: C(d) = md -n[exponent] +b." Estimates of effective radius of a macro-pollution zone can now be determined.]

- Beckett, RP/ Brown, DH 1984: The control of cadmium uptake in the lichen genus Peltigera. - *Journal of Experimental Botany* **35**: 1071-1082. [RLL# 122-8]
CADMIUM/ UPTAKE/ PELTIGERA/ LIGHT/ HEAVY METALS
5 figures. 5 tables. ["It is hypothesized that light-stimulated Cd uptake represents active entry into algal cells, but with uptake in the dark it is not clear which symbiont is involved, and whether energy is required."]

- Beckett, RP/ Brown, DH 1984: The relationship between cadmium uptake and heavy metal tolerance in the lichen genus Peltigera. - *New Phytologist* **97**: 301-311. [RLL# 121-2]
CADMIUM/ HEAVY METALS/ UPTAKE/ PELTIGERA
3 tables. 6 figures. [Authors investigated intra- and extra-cellular Cd uptake in Peltigera spp. from sites with contrasting metal status. "It seems likely that metal tolerance in Peltigera occurs by a variety of mechanisms which vary according to the nature and extent of the metal stress imposed on them."]

- Bennett, JP/ Buchen, MJ 1995: BIOLEFF: three databases on air pollution effects on vegetation. - *Environmental Pollution* **88**: 261-265. [RLL# 166]
AIR POLLUTION/ ASKSAM/ BIBLIOGRAPHY/ BIOINDICATION/ HEAVY METALS
3 fig. 5 tab. [Description of three databases with ca. 4, 000 journal articles, including one on lichen studies.]

- Bennett, JP/ Dibben, MJ/ Lyman, KJ 1996: Element concentrations in the lichen Hypogymnia physodes (L.) Nyl. after 3 years of transplanting along Lake Michigan. - *Environmental and Experimental Botany* **36(3)**: 255-270. [RLL# 166]
AIR POLLUTION/ HEAVY METALS/ HYPOGYMNIA/ INDIANA DUNES NATIONAL LAKESHORE/ TRANSPLANTATION
7 fig. 4 tab. [Transplant study conducted at Indiana Dunes National Lakeshore.]

- Bertrand, D 1954: Recherches sur le lithium chez les cryptogames. - *Bull. Soc. Chim. Biol.* **36(6-7)**: 907-909. [RLL# 21]
LITHIUM/ PARMELIA CAPERATA/ METALS
2 tab. [Lithium in Parmelia caperata.]

- Bieber, W/ Benetka, E/ Türk, R 1999: Contrastive analysis of heavy metals in lichens in alpine national parks in Alaska, Canada and Austria. - *Phyton [Austria]* **39(1)**: 71-78. [RLL# 181]
ALPINE/ CADMIUM/ COPPER/ ELEMENT ANALYSIS/ HEAVY METALS/ LEAD/ ZINC
2 fig. 2 tab.

- Blum, OB/ Tutunnik, UG 1985: Historical biomonitoring of lead content in the atmosphere by means of lichens. - *Dopovidi Akademii Nauk Ukrainskoi RSR, Seriya B* **1985 (10)**: 52-54. [RLL# 130]
USSR/ UKRAINE/ AIR POLLUTION/ LEAD/ HEAVY METALS/ KIEV

2 figures. [Study of lead accumulation around Kiev. "The Pb content in the town lichen is established to be approximately 2.5-fold increased for the mentioned period. This method may be successfully applied for controlling the atmospheric air pollutions with heavy metals." In Ukrainian; English summary.]

- Booer, JR 1951: The action of mercury as a soil fungicide. - *Ann. Appl. Biol.* **38**: 334-347. [RLL# 13]
MERCURY/ HEAVY METALS/ SOILS/ FUNGICIDE/ GROWTH
10 fig. [The growth of lichens (but not of lichen algae) and mosses inhibited by Hg.]

- Boonpragob, K/ Nash, TH", III 1990: Seasonal variation of elemental status in the lichen Ramalina menziesii Tayl. from two sites in Southern California: evidence for dry deposition accumulation. - *Environmental and Experimental Botany* **30(4)**: 415-428. [RLL# 142]
SEASONAL VARIATION/ RAMALINA MENZIESII/ CALIFORNIA/ METALS/ TRANSPLANTS/ AIR POLLUTION
4 figures. 4 tables. [Transplant study in California in relation to air pollution levels. "Total concentration of most elements did not exhibit distinct seasonal patterns but the higher concentrations exceeded background levels by factors of 1.3-3.7, depending on the element. In contrast, the elements in the leachates at the control and the polluted site exhibited distinct seasonal patterns with higher concentrations generally present in summer than in winter. These elemental patterns reflected not only atmospheric deposition patterns, but also intracellular release of elements as injury occurred and to a lesser extent accumulation of marine aerosols and soil particulates."]

- Branquinho, C/ Brown, DH 1994: A method for studying the cellular location of lead in lichens. - *Lichenologist* **26**: 83-90. [RLL# 155]
ELEMENT ANALYSIS/ LEAD/ METALS
1 fig. 6 tab.

- Branquinho, C/ Figueira, R/ Catarino, F 1994: Líquenes como biomonitores de metais pesados associados a tráfego rodoviário. - *In:* : *Actas da 4a Conferência Nacional sobre a Qualidade do Ambiente (Lisboa, 6-8 Abril, 1994)*. 3. Universidade Nova de Lisboa, Lisbon pp. 175-182. [RLL# 166]
BIOMONITORING/ COPPER/ HEAVY METALS/ LEAD/ TRANSPLANTS/ ZINC
3 fig.

- Branquinho, C/ Catarino, F/ Brown, DH/ Pereira, MJ/ Soares, A 1999: Improving the use of lichens as biomonitors of atmospheric metal pollution. - *Science of the Total Environment* **232**: 67-77. [RLL# 179]
ATMOSPHERIC DEPOSITION/ BIODIVERSITY/ CELLULAR LOCATION/ CHLOROPHYLL FLUORESCENCE/ CU/ DUST/ K/ MG/ MINING/ RAMALINA
7 fig. 2 tab.
- Brodo, IM" (ed.) 1978: *International Lichenological Newsletter. Vol. 11. No. 1. April 1978*. - . 15 pp. [RLL# 100]
NEWSLETTER/ IAL/ HEAVY METALS/ POLLUTION
[With an editorial, "Lichens and 'heavy' metals, " by E. Neiboer and D. Richardson; portraits of G. Degelius and the late Valentine Allorge.]

- Brown, DH 1991: [*Review of:*] A. J. Shaw (ed.): Heavy Metal Tolerance in Plants: Evolutionary Aspects. CRC Press, Boca Raton. 1990. - *Lichenologist* **23(1)**: 93-94. [RLL# 143]
REVIEW/ HEAVY METALS

- Brown, DH 1991: Lichen mineral studies -- currently clarified or confused. - *Symbiosis* **11(2-3)**: 207-223. [RLL# 148]
METAL UPTAKE/ MINERAL
2 tab. ["A critical review of lichen mineral studies is presented. Emphasis is placed on laboratory studies that discriminate between extracellular exchangeable binding and intracellular uptake of metals, biomonitoring studies and the significance of trapped particulate matter, and the role of biogenic metal-rich crystals in rock-weathering studies."]

- Brown, DH 1995: Sequential elution procedures for establishing the cellular distribution patterns of metals in cryptogamic plants. - *In:* Munawar, M/Hänninen, O/Roy, S/Munawar, N/Kärenlampi, L/Brown, D (eds.): *Bioindicators of Environmental Health*. . Ecovision World Monograph Series, SPB Academic Publishing, Amsterdam pp. 203-209. [RLL# 166]
AIR POLLUTION/ METALS/ METHODS/ MINERAL ELEMENTS

- Brown, DH/ Beckett, RP 1984: Uptake and effect of cations on lichen metabolism. - *Lichenologist* **16**: 173-188. [RLL# 121-7]
HEAVY METALS/ UPTAKE/ CATIONS/ PELTIGERA/ OWN/ REVIEW/ CADMIUM
11 figures. 1 table. [Review of heavy metal uptake including discussion of particulate trapping, uptake kinetics and energetics, effects on growth, morphology and physiology. Authors also emphasize studies on Peltigera species and recent work on cadmium uptake kinetics.]

- Brown, DH/ Beckett, RP 1985: The role of the cell wall in the intracellular uptake of cations by lichens. - *In:* D. H. Brown (ed.): *Lichen Physiology and Cell Biology*. . Plenum Press, New York and London pp. 247-258. [RLL# 127-23]
UPTAKE/ CATION EXCHANGE/ PHYSIOLOGY/ HEAVY METALS/ PELTIGERA/ CLADONIA/ CADMIUM/ POTASSIUM
6 figures. [Studies on Cd with Peltigera and Cladonia species. ["The data presented here show that while the cell wall cation exchange sites may accumulate heavy metal cations, binding potentially toxic elements at these sites does not necessarily prevent their subsequent uptake into the cell."]

- Brown, DH/ Slingsby, DR 1972: The cellular location of lead and potassium in the lichen Cladonia rangiformis (L.) Hoffm.. - *New Phytol.* **71**: 297-305. [RLL# 83]
LEAD/ POTASSIUM/ LOCALIZATION/ CLADONIA/ CLADINA/ POLLUTION/ CELL WALL
2 fig. 3 tab. ["The reported tolerance of lichens to heavy metals is discussed in relation to the demonstrated location of lead" in the cell wall.]

- Buck, WR/ Harris, RC/ Shaw, AJ/ Piercey-Normore, MD/ Tabaee, A/ Antonovics, J/ Crone, EE 1999: Unusual lichens under electricity pylons on zinc-enriched soil. - *The Bryologist* **102(1)**: 130-132. [RLL# 175]
METAL POLLUTION/ NORTH AMERICA/ NORTH CAROLINA/ STEINIA/ VEZDAEA/ ZINC
1 tab. [New to North America (North Carolina): Vezdaea leprosa, Steinia geophana.]

- Burton, MAS/ LeSuer, P/ Puckett, KJ 1981: Copper, nickel, and thallium uptake by the lichen Cladina rangiferina. - *Canadian Journal of Botany* **59**: 91-100. [RLL# 109-9]
THALLIUM/ NICKEL/ COPPER/ UPTAKE/ PH/ CATION EXCHANGE/ HEAVY METALS/ CLADINA
7 figures. 8 tables. [Affinity for nickel was lower than for copper or thallium, but was very pH dependent. Cation exchange studies were also conducted.]

- Campbell, JA 1976: A mathematical treatment of the variation of heavy-metal content of lichens with distance from a source. - *Lichenologist* **8**: 83-86. [RLL# 95]
VARIATION/ HEAVY METALS/ AIR POLLUTION/ DISTRIBUTION/ MODELS

- Caniglia, G/ Calliari, I/ Celin, L/ Tollardo, AM 1994: Metal determination by EDXRF in lichens. A contribution to pollutants monitoring. - *Biological Trace Element Research* **43(5)**: 213-221. [RLL# 158]
AIR POLLUTION/ BIOMONITORING/ EVERNIA/ TRANSPLANTS
2 fig. 2 tab. [Energy dispersive X-ray fluorescence (EDXRF) was used to determine metals in transplanted Evernia prunastri thalli.]

- Caniglia, G/ Laveder, C/ Zocca, C/ Calliari, I/ Zorer, R 1993: Bioaccumulation of elements on thalli of Pseudevernia furfuracea exposed in urban and rural sites. - *Giornale Botanico Italiano* **127(3)**: 621. [RLL# 158]
AIR POLLUTION/ HEAVY METALS/ ITALY

- Castello, M/ Nimis, PL/ Alleteo, D/ Bellio, MG 1994: Biomonitoring of SO2 and metal pollution with lichens and barks in Savona (N Italy) [Biomonitoraggio di inquinamento da anidride solforosa e metalli basato sull'uso di licheni e scorze nell'area circostante Savona (Liguria)]. - *Bolletino della Società Adriatica di Scienze* **75(1)**: 61-83. [RLL# 159]
AIR POLLUTION/ BIOMONITORING/ ITALY/ METAL POLLUTION/ SO2
17 fig. 4 tab.

- Castello, M/ Nimis, PL/ Cebulec, E/ Mosca, R 1995: Air quality assessment by lichens as bioindicators of SO2 and bioaccumulators of heavy metals in the province of Trieste (NE Italy). - *In:* : *Responses of Plants to Air Pollution. Biological and Economic Aspects*. . Agricoltura Mediterrancea, Special Volume, Pacini Editore, pp. 233-243. [RLL# 167]
AIR POLLUTION/ BIOINDICATORS/ EPIPHYTIC/ IAP/ ITALY/ TRIESTE
16 fig. 2 tab.

• Chettri, MK/ Sawidis, T 1997: Impact of heavy metals on water loss from lichen thalli. - *Ecotoxicology and Environmental Safety* **37**: 103-111. [RLL# 169]
CLADONIA/ HEAVY METALS/ WATER RELATIONS
8 fig. 2 tab. [Laboratory studies using Cladonia convoluta and C. rangiformis.]

• Chettri, MK/ Sawidis, T/ Karataglis, S 1997: Lichens as a tool for biogeochemical prospecting. - *Ecotoxicology and Environmental Safety* **38**: 322-335. [RLL# 174]
BIOGEOCHEMISTRY/ GREECE/ HEAVY METALS/ METAL ACCUMULATION/ PROSPECTING
9 fig. 1 tab.

• Chettri, MK/ Sawidis, T/ Zachariadis, GA/ Stratis, JA 1997: Uptake of heavy metals by living and dead Cladonia thalli. - *Environmental and Experimental Botany* **37(1)**: 39-52. [RLL# 175]
CLADONIA/ HEAVY METALS/ UPTAKE
8 fig. 3 tab.

• Chiarenzelli, JR/ Aspler, LB/ Ozarko, DL/ Hall, GEM/ Powis, KB/ Donaldson, JA 1997: Heavy metals in lichens, southern district of Keewatin, Northwest Territories, Canada. - *Chemosphere* **35(6)**: 1329-1341. [RLL# 169]
AIR POLLUTION/ HEAVY METALS/ KEEWATIN/ NORTHWEST TERRITORIES/ SUBSTRATE
3 fig. 2 tab. [Twelve saxicolous species were analyzed for As, Cd, Cr, Cu, Ni, Pb, Sb, V, and Zn.]

• Chipev, N/ Kovachev, A 1999: Preliminary data of heavy metal contents in lichens from the Livingston Island (the Antarctic). - *Bulgarian Antarctic Research Life Sciences* **2**: 106-109. [RLL# 179]
ANTARCTIC/ CU/ FE/ HEAVY METALS/ MN/ PB/ ZN
1 tab.

• Connor, JJ 1979: Geochemistry of ohia and soil lichen, Puhimau thermal area, Hawaii. - *Science of the Total Environment* **12**: 241-250. [RLL# 105-19]
HAWAII/ CLADONIA/ SELENIUM/ MERCURY/ HEAVY METALS
3 figures. 2 tables. [Analysis of samples of Cladonia skottsbergii Magn. for selenium and mercury confirmed observations on leaves of the ohia tree (Metrosidros collina (Gaud.) Rock.) that the steaming area is a natural source of atmospheric contamination. Other elements reflected the same increased accumulations, incorporated probably as sulfates.]

• Crête, M/ Lefebvre, MA/ Zikovsky, L/ Walsh, P 1992: Cadmium, lead, mercury and 137cesium in fruticose lichens of northern Québec. - *Science of the Total Environment* **121**: 217-230. [RLL# 149]
CADMIUM/ CARIBOU/ CESIUM/ HEAVY METALS/ MERCURY/ QUEBEC
2 fig. 5 tab.

• Crowder, A 1991: Acidification, metals and macrophytes. - *Environmental Pollution* **71**: 171-203. [RLL# 166]
ALUMINUM/ CADMIUM/ HEAVY METALS/ LEAD/ MERCURY/ METAL ACCUMULATION/ METAL UPTAKE
2 fig. [Includes brief discussion of metal uptake in lichens.]

• Cuny, D/ Van Haluwyn, C/ Shirali, P 2000: The concept of biomarker in lichenology - Application in bioindication survey. - *In:* : *The Fourth IAL Symposium, Progress and Problems in Lichenology at the Turn of the Millennium*. . Universitat de Barcelona, Barcelona pp. 115. [RLL# 181]
BIOINDICATION/ ELEMENT ANALYSIS/ FRANCE/ HEAVY METALS/ TRANSPLANTS
[Abstract from the International Association for Lichenology's fourth symposium, held in Barcelona, Spain, 3-8 September 2000.]

• Czehura, SJ 1977: A lichen indicator of copper mineralization, Lights Creek district, Plumas County, California. - *Econ. Geol.* **72**: 796-803. [RLL# 100]
COPPER/ HEAVY METALS/ LECANORA/ MINERALIZATION/ ABSORPTION/ UPTAKE/ CALIFORNIA
5 figures. 1 table. ["Color differences in the thalli of Lecanora cascadensis Magn. correspond well with copper mineralization .... Apparently the lichen's anomalous green color is due to its ability to absorb and concentrate copper." Colored illustration.]

• Dillman, KL 1996: Use of the lichen Rhizoplaca melanophthalma as a biomonitor in relation to phosphate refineries near Pocatello, Idaho. - *Environmental Pollution* **92(1)**: 91-96. [RLL# 165]

AIR POLLUTION/ ARID LANDS/ BIOMONITORING/ HEAVY METALS/ IDAHO/ PHOSPHATE REFINERIES/ SEMIARID LAND
3 fig. 2 tab.

- Dongarrà, G/ Ottonello, D/ Sabatino, G/ Triscari, M 1994: Preliminary data on heavy metal content in lichens from North Eastern Sicily. - *Mineralogia Petrographica Acta* **37**: 141-153. [RLL# 166]
BIOGEOCHEMISTRY/ HEAVY METALS/ PROSPECTING/ SICILY
6 fig. 3 tab. [Biogeochemical prospecting using Xanthoria calcicola.]

- Dongarrà, G/ Ottonello, D/ Sabatino, G/ Triscari, M 1995: Use of lichens in detecting environmental risk and in geochemical prospecting. - *Environmental Geology* **26(3)**: 139-146. [RLL# 164]
GEOCHEMICAL PROSPECTING/ ITALY/ METAL ACCUMULATION/ POLLUTION/ SICILY
7 fig. 2 tab. [Study of metals in Xanthoria calcicola from an industrial zone and from ore containing areas in northeastern Sicily.]

- Dubey, AN/ Pandey, V/ Upreti, DK/ Singh, J 1999: Accumulation of lead by lichens growing in and around Faizabad, U.P. India. - *Journal of Environmental Biology* **20(3)**: 223-225. [RLL# 180]
ACCUMULATION/ AIR POLLUTION/ HEAVY METALS/ INDIA/ LEAD/ UTTAR PRADESH
1 tab.

- Erdman, JA/ Gough, LP 1977: Variation in the element content of Parmelia chlorochroa from the Powder River Basin of Wyoming and Montana. - *The Bryologist* **80**: 292-300. [RLL# 98]
XANTHOPARMELIA/ ELEMENT CONTENT/ VARIATION/ MONTANA/ WYOMING/ AIR POLLUTION/ HEAVY METALS
2 figures. 3 tables.

- Farkas, E/ Lokos, L/ Verseghy, K 1985: Lichens as indicators of air pollution in the Budapest agglomeration. I. Air pollution map based on floristic data and heavy metal concentration measurements. - *Acta Botanica Hungarica* **31**: 45-68. [RLL# 128-33]
AIR POLLUTION/ HUNGARY/ BUDAPEST/ HEAVY METALS/ HYPOGYMNIA/ TRANSPLANTS/ CLADONIA/ LEAD/ ECOLOGY
5 tables. 17 figures. [Study of air pollution in the Budapest region included heavy metal measurements of transplants of Hypogymnia physodes and Cladonia convoluta. "A lichen zone map was drawn according to the distribution of epiphytic lichen species. This map was compared to a sulphur dioxide zone map, to the distribution map of lichens compiled about 70 years ago ...." Authors conclude that " ... the reasons for impoverishment of lichen flora are the lead pollution caused by increased traffic, sulphur dioxide pollution originated from heating, the decrease of area covered by natural or seminatural vegetation, the increase of built-up areas, the warmer and drier urban climate and, finally, substrate effects."]

- Figueira, R/ Sousa, AJ/ Pacheco, AMG/ Catarino, F 1999: Biominotorizaçao da deposiçao atmosférica de metais pesados e elementos salinos no litoral alentejano através de líquenes. - *In:* : *Actas da 6a Conferência Nacional Sobre a Qualidade do Ambiente*. . Universidade Nova de Lisboa, Lisbon pp. 301-305. [RLL# 179]
AIR POLLUTION/ BIOMONITORING/ RAMALINA/ SALINITY/ SEA SALT/ TRACE METALS
2 fig. [Results of a conference held in Lisbon, 20-22 October 1999.]

- Folkeson, L 1979: Interspecies calibration of heavy-metal concentrations in nine mosses and lichens: --applicability to deposition measurements. - *Water, Air, and Soil Pollution* **11**: 253-260. [RLL# 107-24]
HEAVY METALS/ DEPOSITION/ POLLUTION/ TECHNIQUE
3 tables. [Five lichens used. With the help of calibration factors, "... concentrations in a species not found in a certain site can be estimated from concentrations measured in any of the other species sampled."]

- Folkeson, L 1984: Deterioration of the moss and lichen vegetation in a forest polluted by heavy metals. - *Ambio* **13**: 37-39. [RLL# 123-35]
SWEDEN/ AIR POLLUTION/ ZINC/ COPPER
3 figures. [Copper and zinc pollution in SE Sweden was studied around brass mills. "The moss and lichen vegetation of the forest floor is markedly impoverished in the area. The ground layer, normally covering 25-90 percent of the forest floor, is reduced to less than 1 percent in the vicinity of the mills."]

- Ford, J/ Landers, D/ Kugler, D/ Lasorsa, B/ Allen-Gil, S/ Crecelius, E/ Martinson, J 1995: Inorganic contaminants in Arctic Alaskan ecosystems: long-range atmospheric transport or local point sources. - *Science of the Total Environment* **160/161**: 323-335. [RLL# 166]
AIR POLLUTION/ ALASKA/ ARCTIC/ CADMIUM/ HEAVY METALS/ LEAD/ MOSSES
3 fig. 5 tab. [Includes data for Cetraria cucullata.]

- Freitas, MC 1994: Heavy metals in Parmelia sulcata collected in the neighborhood of a coal-fired power station. - *Biological Trace Element Research* **43(5)**: 207-212. [RLL# 158]
AIR POLLUTION/ COAL-FIRED POWER PLANT/ HEAVY METALS/ NEUTRON ACTIVATION ANALYSIS
3 fig. 2 tab. [Use of k0-based instrumental neutron activation analysis to determine heavy metals.]

- Freitas, MC/ Afonso, MH/ Almeida, C/ Alves, LC/ Araújo, MF/ Barreiros, MA/ Seabra e Barros, J/ Bordalo Costa, M/ Gouveia, MA/ Reis, MA 1995: Intercomparison of techniques available at INETI in the analysis of two IAEA candidate research materials. - *Biological Trace Element Research* **43(5)**: 549-560. [RLL# 158]
AIR POLLUTION/ HEAVY METALS/ NEUTRON ACTIVATION ANALYSIS
1 fig. 4 tab. [Study using Parmelia sulcata and a variety of nuclear techniques and atomic methods.]

- Freitas, MC/ Nobre, AS 1997: Bioaccumulation of heavy metals using Parmelia sulcata and Parmelia caperata for air pollution studies. - *Journal of Radioanalytical and Nuclear Chemistry* **217(1)**: 17-20. [RLL# 169]
AIR POLLUTION/ BIOMONITORING/ HEAVY METALS/ INAA/ PORTUGAL/ TRACE ELEMENTS
4 fig.

- Freitas, MC/ Reis, MA/ Alves, LC/ Wolterbeek, HT 1999: Distribution in Portugal of some pollutants in the lichen Parmelia sulcata. - *Environmental Pollution* **106**: 229-235. [RLL# 179]
AIR POLLUTION/ PORTUGAL/ TRACE METALS
10 fig. 2 tab.

- Frenzel, RW/ Witmer, GW/ Starkey, EE 1990: Heavy metal concentrations in a lichen of Mt. Rainier and Olympic National Parks, Washington, USA. - *Bulletin of Environmental Contamination and Toxicology* **44(1)**: 158-164. [RLL# 143]
HEAVY METALS/ MT. RAINIER/ OLYMPIC NATIONAL PARK/ ALECTORIA/ WASHINGTON
2 tables. 1 figure. [Concentrations were found to be far below toxic levels in Alectoria sarmentosa.]

- Frigoli, G/ Quartieri, M 1999: Biomonitoring of atmospheric deposition of heavy metals by means of the lichen Parmelia sulcata in an urbanized area. - *Annali di Chimica* **89**: 711-719. [RLL# 181]
AIR POLLUTION/ ATMOSPHERIC DEPOSITION/ BIOINDICATION/ ELEMENT ANALYSIS/ HEAVY METALS/ PARMELIA
7 fig. 1 tab.

- Gailey, FAY/ Smith, GH/ Rintoul, LJ/ Lloyd, OL 1985: Metal deposition patterns in central Scotland, as determined by lichen transplants. - *Environmental Monitoring and Assessment* **5**: 291-309. [RLL# 130]
HEAVY METALS/ AIR POLLUTION/ SCOTLAND/ BRITISH ISLES/ HYPOGYMNIA/ TRANSPLANTS
9 tables. 8 figures. ["Lichen transplants of Hypogymnia physodes were used in a high-density network ofsites for collecting airborne metals from the atmosphere in Armadale, a small industrial town in central Scotland. The mapping of the concentrations of various metals revealed a gradient of metal values which decreased outwards from the town's steel foundry."]

- Gailey, FAY/ Lloyd, OL 1993: Spatial and temporal patterns of airborne metal pollution: the value of low technology sampling to an environmental epidemiology study. - *Science of the Total Environment* **133**: 201-219. [RLL# 166]
AIR POLLUTION/ HYPOGYMNIA/ METAL POLLUTION/ STEEL WORKS/ TRANSPLANTS
1 fig. 8 tab. [Study in Scotland of atmospheric metal contamination using Lecanora conizaeoides and transplanted Hypogymnia physodes.]

- Galun, M/ Garty, J/ Ronen, R 1984: Lichens as bioindicators of air pollution. - *Webbia* **38**: 371-383. [RLL# 126-29]
AIR POLLUTION/ ISRAEL/ HEAVY METALS/ ACCUMULATION/ RAMALINA/ CALOPLACA/ OWN
4 tables. 4 maps. [General summary with examples of heavy metal accumulation data on Ramalina duriaei and Caloplaca aurantia from sites in Israel.]

• Galun, M/ Ronen, R 1988: Interactions of lichens and pollutants. - *In:* M. Galun (ed.): *CRC Handbook of Lichenology. Volume III*. . CRC Press, Inc., Boca Raton pp. 55-72. [RLL# 138]
AIR POLLUTION/ POLLUTANTS/ PHYSIOLOGY/ MAPPING/ UPTAKE/ HEAVY METALS
5 tables. 3 figures. [Review of lichen interactions with pollutants including SO2, heavy metals, radionuclides, and others. Discussion includes notes on ecosystem alteration and mapping, transplants, morphological and cytological changes, and metabolic and physiological effects. Bibliography contains 107 references.]

• Garty, J 1985: The amounts of heavy metals in some lichens of the Negev Desert. - *Environmental Pollution, Series B* **10**: 287-300. [RLL# 128-36]
HEAVY METALS/ ISRAEL/ SQUAMARINA/ TELOSCHISTES/ RAMALINA/ DIPLOSCHISTES/ CALOPLACA/ DESERT/ ECOLOGY/ NEGEV
1 figure. 11 tables. [Analyses of amounts of Mn, Cr, Pb, Zn, Cu and Ni in Squamarina crassa, Teloschistes lacunosus, Ramalina maciformis, Diploschistes streppicus and Caloplaca ehrenbergii from Israel. "Measuring the heavy metal content of desert lichens is important because of their biomonitoring potential and also because snails and goats feed on them."]

• Garty, J 1987: Metal amounts in the lichen Ramalina duriaei (De Not.) Bagl. transplanted at biomonitoring sites around a new coal-fired power station after 1 year of operation. - *Environmental Research* **43(1)**: 104-116. [RLL# 134]
ISRAEL/ TRANSPLANTS/ LEAD/ COPPER/ NICKEL/ AIR POLLUTION/ METALS/ ZINC/ CROP SPRAYING
8 tables. 1 figure. [Transplants to 22 sites for 1 year in Israel compared to transplants two years earlier. "The increase in amounts of some of the metals in the 1981-82 lichen material (Pb, Ni, and probably Cr) reflects the increase in the total number of motor vehicles between the two periods within the study area. The decrease of Zn in the lichen after the second period reflects a decrease in the use of Zn as a constituent of foliar nutrients in agriculture used for crop spraying."]

• Garty, J 1988: Comparisons between the metal content of a transplanted lichen before and after the start-up of a coal-fired power station in Israel. - *Canadian Journal of Botany* **66(4)**: 668-671. [RLL# 139]
AIR POLLUTION/ TRANSPLANTS/ ISRAEL/ POWER PLANTS/ NICKEL/ LEAD/ CHROMIUM/ HEAVY METALS/ RAMALINA
4 tables. 1 figure. [Study on Ramalina duriaei transplants. "After the 1981-1982 period, the regional amounts of Ni, Cr, and Pb in the transplanted lichen were found to be higher than in the lichen transplanted to the same sites during the 1979-1980 period, prior to the operation of the coal-fired power plant." Lead increases were probably from vehicles, while changes in the other metals were most likely from power plant emissions.]

• Garty, J 1993: Lichens as Biomonitors for Heavy Metal Pollution. - *In:* Markert, B (ed.): *Plants as Biomonitors. Indicators for Heavy Metals in the Terrestrial Environment*. . VCH, Weinheim pp. 193-263. [RLL# 156]
AIR POLLUTION/ BIOMONITORING/ HEAVY METALS
15 fig. 7 tab. [Extensive review with many references.]

• Garty, J 1993: Lichens as Biomonitors for Heavy metal pollution. - *In:* Markert, B (ed.): *Plants as Biomonitors. Indicators for Heavy Metals in the Terrestrial Environment*. . VCH, Weinheim pp. 193-263. [RLL# 156]
AIR POLLUTION/ BIOMONITORING/ HEAVY METALS
15 fig. 7 tab. [Extensive review with many references.]

• Garty, J/ Ammann, K 1987: The amounts of Ni, Cr, Zn, Pb, Cu, Fe and Mn in some lichens growing in Switzerland. - *Environmental and Experimental Botany* **27**: 127-138. [RLL# 132]
HEAVY METALS/ AIR POLLUTION/ MACROLICHENS/ SWITZERLAND
7 tables. [Study of seven macrolichen species. "By the use of intersite, interelement, and interspecies comparisons, it is concluded that some metals within the thalli of Swiss lichens may reach high levels even when these plants are growing in rural and isolated sites."]

• Garty, J/ Fuchs, C 1982: Heavy metals in the lichen Ramalina duriaei transplanted in biomonitoring stations. - *Water, Air, and Soil Pollution* **17**: 175-183. [RLL# 114-29]
HEAVY METAL/ RAMALINA/ ISRAEL/ AIR POLLUTION/ TRANSPLANT
2 figures. 4 tables. [The metals Cu, Cr, Cd, Pb, Zn and Ni were determined at sites in Israel. "The contents of these metals in the material exposed for 1 yr at the site which served as a source for the transplantation were found to be much lower than in the lichen transplanted close by busy roads and to places with other intensive human activities."]

• Garty, J/ Galun, M/ Fuchs, C/ Zisapel, N 1977: Heavy metals in the lichen Caloplaca aurantia from urban, suburban and rural regions in Israel (a comparative study). - *Water Air Soil Pollut.* **8**: 171-188. [RLL# 99]

HEAVY METALS/ CALOPLACA/ AIR POLLUTION/ ISRAEL
3 figures. 8 tables.

- Garty, J/ Galun, M/ Hochberg, Y 1986: The accumulation of metals in Caloplaca aurantia growng on concrete roof tiles. - *Lichenologist* **18**: 257-263. [RLL# 128-37]
CONCRETE/ CALOPLACA/ HEAVY METALS/ ISRAEL/ POLLUTION/ ACCUMULATION
9 tables. 1 figure. [Accumulation of heavy metals correlates well with the ambient metal concentration, and the concentrations in the lichen is many times higher than the substratum.]

- Glenn, MG/ Gomez-Bolea, A/ Lobello, R 1995: Metal content and community structure of cryptogam bioindicators in relation to vehicular traffic in Montseny Biosphere Reserve (Catalonia, Spain). - *Lichenologist* **27(4)**: 291-304. [RLL# 160]
AIR POLLUTION/ AUTOMOBILE EXHAUST/ AUTOMOBILES/ COPPER/ LEAD/ METAL POLLUTION/ METALS/ SPAIN/ ZINC
9 fig. 2 tab. ["The health, abundance, metal content and species richness of corticolous macrolichens and bryophytes of Quercus ilex were compared at nine roadside stations in Montseny Biosphere Reserve, 40 km NNE of Barcelona, and at a control site outside the industrial metropolis."]

- Glenn, MG/ Orsi, EV/ Hemsley, ME 1991: Lichen metal contents as correlates of air filter measurements. - *Grana* **30**: 44-47. [RLL# 153]
AIR POLLUTION/ METAL POLLUTION
2 fig. 2 tab. [Study comparing the Pb, Zn and Cu content in lichens (Parmelia caperata, Cladina rangiferina) and air-borne particulates at three sites at increasing distances from New York City.]

- Grodzinska, K/ Godzik, B/ Szarek, G 1993: Heavy metals and sulphur in lichens from southern Spitsbergen. - *Fragmenta Floristica et Geobotanica Supplementum* **2(2)**: 699-708. [RLL# 157]
HEAVY METALS/ MINERAL ELEMENTS/ SPITSBERGEN/ SULFUR
5 fig. 2 tab.

- Haas, JR/ Bailey, EH/ Purvis, OW 1998: Bioaccumulation of metals by lichens: uptake of aqueous uranium by Peltigera membranacea as a function of time and pH. - *American Mineralogist* **83(11-12)**: 1494-1502. [RLL# 175]
PELTIGERA/ PH/ TEMPORAL PATTERNS/ UPTAKE/ URANIUM
5 fig. 1 tab.

- Hajdúk, J/ Lisická, E 1999: Cladonia rei (lichenizované askomyéty) na stanovistiach kontaminovanych imisiami z Kovohút Krompachy (SV Slovensko) [Cladonia rei (lichenized Ascomycotina) on heavy metal-contaminated habitats near copper smelters at Krompachy (NE Slovakia)]. - *Bulletin Slovenskej Botanickej Spolocnosti* **21**: 49-51. [RLL# 179]
CLADONIA/ COPPER SMELTER/ HEAVY METALS/ SLOVAKIA/ TERRICOLOUS LICHENS
[This uncommon lichen was very abundant on bare acid soil (with the moss Ceratodon purpureus), where all vascular plants are severely damaged or have disappeared.]

- Hansen, ES 1991: The lichen flora near a lead-zinc mine at Maarmorilik in West Greenland. - *Lichenologist* **23(4)**: 381-391. [RLL#]
GREENLAND/ HEAVY METALS/ POLLUTION
2 fig. [Reports 87 lichen taxa.]

- Hansen, ES 1999: Epilithic lichens on iron- and copper-containing crusts at Qeqertarsuaq, Central West Greenland. - *Graphis Scripta* **10(1/2)**: 7-12. [RLL# 175]
COPPER/ GREENLAND/ IRON/ METALS/ SAXICOLOUS LICHENS/ SUBSTRATE
2 fig.

- Heliotis, FD/ Karandinos, MG/ Whiton, JC 1988: Air pollution and the decline of the fir forest in Parnis National Park, near Athens, Greece. - *Environmental Pollution* **54(1)**: 29-40. [RLL# 139]
AIR POLLUTION/ GREECE/ ECOLOGY/ HEAVY METALS
2 Tables. 3 figures. ["Lichen samples from the southeast site had significantly higher levels of Pb, Zn, Cd, Cu, Al, Mo, Mn and N than samples from the north site. We suggest that air pollution could be contributing to the decline of the forest."]

- Henriksson, LE/ DaSilva, EJ 1978: Effect of some inorganic elements on nitrogen-fixation in blue-green algae and some ecologial aspects of pollution. - *Zeitschrift fur Allgemeine Mikrobiologie* **18**: 487-494. [RLL# 102-34]
CYANOBACTERIA/ HEAVY METALS/ ARSENIC/ ZINC/ LEAD/ NICKEL/ NOSTOC/ COLLEMA/ NITROGEN FIXATION/ POLLUTION
6 figures. 1 table. [Various concentrations of heavy metals, arsenic, cadmium, nickel, lead, palladium and zinc were tested on cultures of several blue-green algae including a Nostoc sp. derived from Collema tenax. Generally, lower concentrations were stimulatory to nitrogen fixation while high concentrations wer inhibitory.]

- Herzig, R 1993: Multi-Residue Analysis with Passive Biomonitoring: A New Approach for Volatile Multi-Element Contents, Heavy metals and Polycyclic Aromatic Hydrocarbons with Lichens in Switzerland and the Prinicpality of Liechtenstein. - *In:* Markert, B (ed.): *Plants as Biomonitors. Indicators for Heavy Metals in the Terrestrial Environment*. . VCH, Weinheim pp. 285-328. [RLL# 156]
BIOINDICATORS/ BIOMONITORING/ HEAVY METALS/ POLLUTION
14 fig. 11 tab.

- Huneck, S/ Bothe, K/ Richter, W 1990: Über den Metallgehalt von Flechten von Kupferschieferhalden der Umgebung von Mansfeld. - *Herzogia* **8**: 295-304. [RLL#]
COPPER SCHIST/ METALS
1 fig. 2 tab. [An X-ray fluorescence study of lichen metal content.]

- Ingemansson, T/ Erlandsson, B/ Mattsson, S 1983: Studies of activation products in the terrestrial environments of three Swedish nuclear power stations. - *Environmental Pollution, Series B* **5**: 17-33. [RLL# 119-65]
POLLUTION/ COBALT/ HEAVY METALS/ SWEDEN/ NUCLEAR POWER/ ISOTOPE/ CLADONIA
3 tables. 5 figures. [Cladonia alpestris is included in the study. "These studies have shown that the 60Co activity concentration increases substantially with the first rain runoff that reaches the sewage plant, and then falls off rapidly."]

- Jaakkola, T/ Heinonen, OJ/ Keinonen, M/ Salmi, A/ Miettinen, JK 1983: Use of 206Pb/204Pb isotope ratio in lichen, air filter, incinerator ash and gasoline samples as pollution source indicator. - *International Journal of Mass Spectrometry and Ion Physics* **48**: 347-350. [RLL# 118-36]
LEAD/ ISOTOPES/ AIR POLLUTION/ FINLAND/ HELSINKI/ FALLOUT/ HEAVY METALS
1 figure. 2 tables. [Study in Helsinki showed among other things that "... lead in lichen represents quite well the average lead "fallout" of a time period of many years."]

- Jacquiot, L/ Daillant, O 2000: Bio-accumulation des métaux lourds et d'autres eléments traces par les lichens. Revue bibliographique [Bio-accumulation of heavy metals and other trace-elements by lichens. Review]. - *Bulletin de l'Observatoire Mycologique* **12**: 2-31. [RLL# 181]
ACCUMULATION/ HEAVY METALS/ METAL ACCUMULATION/ REVIEW
2 tab.

- Jayasekera, R/ Rossbach, M 1996: Background levels of heavy metals in plants of different taxonomic groups from a montane rain forest in Sri Lanka. - *Enviromental Geochemistry and Health* **18(2)**: 55-62. [RLL# 176]
EPIPHYTES/ HEAVY METALS/ POLLUTION/ SRI LANKA/ TROPICAL MONTANE FORESTS
2 fig.

- Jenkins, DA/ Davies, RI 1966: Trace element content of organic accumulations. - *Nature* **210**: 1296-1297. [RLL# 62]
SOILS/ TRACE ELEMENTS/ METALS/ ECOLOGY
2 fig. [Lichens and soil formation.]

- Jeran, Z/ Jacimovic, R/ Batic, F/ Smodis, B/ Wolterbeek, HT 1996: Atmospheric heavy metal pollution in Slovenia derived from results for epiphytic lichens. - *Fresenius' Journal of Analytical Chemistry* **354**: 681-687. [RLL# 164]
AIR POLLUTION/ HEAVY METALS/ SLOVENIA
1 fig. 3 tab.

- Jeran, Z/ Jacimovic, R/ Batic, F/ Smodis, B/ Wolterbeek, HT 1996: Atmospheric heavy metal pollution in Slovenia derived from results for epiphytic lichens. - *Fresenius' Journal of Analytical Chemistry* **354**: 681-687. [RLL# 164]
AIR POLLUTION/ HEAVY METALS/ SLOVENIA
1 fig. 3 tab.

- Johnsen, I 1976: Problems in relation to the use of plants as monitors of air pollution with metals. - *In:* L. Karenlampi (ed.): *Proceedings of the Kuopio Meeting on Plant Damages Caused by Air Pollution*. . University of Kuopio, Kuopio pp. 110-114. [RLL# 96]
AIR POLLUTION/ METALS/ MONITORING/ TECHNIQUES

- Jones, D/ Wilson, MJ/ Laundon, JR 1982: Observations on the location and form of lead in Stereocaulon vesuvianum. - *Lichenologist* **14**: 281-286. [RLL# 117-56]
STEREOCAULON/ LEAD/ POLLUTION/ HEAVY METALS/ LOCALIZATION
2 tables. 3 figures. ["In conclusion the information presented above shows for the first time both the location and form of the accumulated lead in S. vesuvianum, provides evidence regarding the source of this lead, and had implications regarding a possible tolerance mechanism."]

- Kanerva, T/ Sarin, O/ Nuorteva, P 1988: Aluminium, iron, zinc, cadmium and mercury in some indicator plants growing in south Finnish forest areas with different degrees of damage. - *Annales Botanici Fennici* **25(3)**: 275-279. [RLL# 136]
FINLAND/ HEAVY METALS/ AIR POLLUTION/ ALUMINUM/ IRON/ ZINC/ CADMIUM/ MERCURY/ HYPOGYMNIA
2 figures. [Hypogymnia physodes was one of the sampled organisms.]

- Kansanen, PH/ Venetvaara, J 1991: Comparison of biological collectors of airborne heavy metals near ferrochrome and steel works. - *Water, Air, and Soil Pollution* **60**: 337-359. [RLL#]
AIR POLLUTION/ CR/ NI
9 fig. 4 tab. ["The value of several biological monitors of the distribution of airborne Cr and Ni dust was studied in the vicinity of ferrochrome and stainless steel works. The following indigenous biomonitors were compared: the forest mosses Pleurozium schreberi and Hylocomium splendens, the epiphytic lichen Hypogymnia physodes, bark of Scots pine (Pinus sylvestris), needle litter, earthworms (Dendrobaena octaedra) and moths (mainly Xylena vetusta). Results were compared and related to the heavy metal deposition estimated by the vertical snow sampling method."]

- Kapu, MM/ Ipaye, MM/ Ega, RAI/ Akanya, HO/ Balarabe, ML/ Schaeffer, DJ 1991: Lichens as bioindicators of aerial fallout of heavy metals in Zaria, Nigeria. - *Bulletin of Environmental Contamination and Toxicology* **47**: 413-416. [RLL#]
AIR POLLUTION/ BIOINDICATORS/ HEAVY METALS/ NIGERIA
3 tab.

- Kauppi, M/ Kauppi, A/ Garty, J 1998: Ethylene produced by the lichen Cladina stellaris exposed to sulphur and heavy-metal-containing solutions under acidic conditions. - *New Phytologist* **139(3)**: 537-547. [RLL# 174]
ACID RAIN/ AIR POLLUTION/ ETHYLENE/ HEAVY METALS/ SULFUR
9 tab.

- Kortesharju, M/ Kortesharju, J 1989: Studies on epiphytic lichens and pine bark in the vicinity of a cement works in northern Finland. - *Silva Fennica* **23(4)**: 301-310. [RLL# 166]
BARK/ BRYORIA/ CALCIUM/ CEMENT/ CEMENT WORKS/ HEAVY METALS/ POLLUTION
4 fig. 3 tab.

- Kral, R/ Kryzova, L/ Liska, J 1989: Background concentrations of lead and cadmium in the lichen Hypogymnia physodes at different altitudes. - *Science of the Total Environment* **84**: 201-209. [RLL# 139]
LEAD/ CADMIUM/ HYPOGYMNIA/ CZECHOLOSLOVAKIA/ AIR POLLUTION/ HEAVY METALS
5 figures. 2 tables. ["The background concentrations of lead and cadmium in the epiphytic lichen Hypogymnia physodes were determined and found to depend on altitude. The lead content increases linearly with increasing altitude, whereas the cadmium content increases up to altitudes of 900-1100m, and then decreases above this height." Study conducted in Czechoslovakia.]

- Kratz, W/ Maguas, C/ Branquinho, C/ Catarino, F/ Sergio, C 1991: Der Einsatz von Epiphyten und aquatischen Moosen für das Schwermetallmonitoring in Portugal. - *VDI Berichte* **901**: 119-132. [RLL# 165]
AIR POLLUTION/ AQUATIC LICHENS/ EPIPHYTES/ HEAVY METALS/ PORTUGAL
2 fig. 2 tab.

- Kwapulinski, J/ Seaward, MRD/ Bylinska, EA 1985: 137Caesium content of Umbilicaria species, with particular reference to altitude. - *Science of the Total Environment* **41**: 125-133. [RLL# 124-68]
CAESIUM/ HEAVY METALS/ ISOTOPES/ POLAND/ UMBILICARIA/ OWN/ ELEVATION

4 figures. 1 table. [Study was conducted in southwest Poland using Umbilicaria cylindrica, U. deusta, U. hirsuta and U. murina. "The data assembled are interpreted graphically and formulae derived to show the influence of altitude on the 137Cs content; in general, the coefficient of accumulation rises with increasing altitude." Umbilicaria cylindrica and U. deusta were the best bioindicators.]

- Kwapulinski, J/ Seaward, MRD/ Bylinska, EA 1985: Uptake of 226radium and 228radium by the lichen genus Umbilicaria. - *Science of the Total Environment* **41**: 135-141. [RLL# 124-69]
POLAND/ OWN/ UMBILICARIA/ ISOTOPES/ HEAVY METALS/ UPTAKE/ RADIUM
3 figures. 1 table. ["The 226Ra and 228Ra content of the lichens Umbilicaria cylindrica, U. deusta, U. murina, and U. hirsuta has been determined as a function of the growth altitude above sea level, based on data derived from material collected from localities in southwest Poland."]

- Lackovicová, A/ Kontrisová, O 1998: Vyuzitie lisajníkov pri hodnotení cistoty ovzdusia v oblasti kovohút na dolnez Orave (sz. Slovensko) [Lichens in evaluation of air quality in the vicinity of the smelters, southern Orava, NW Slovakia]. - *In:* Kontrisová, O/Bublinec, E (eds.): *Monitorovanie a hodnotenie stavu zivotného prostredia FEE TU vo Zvolene a UEL SAV vo Zvolene*. . FEE TU vo Zvolene a UEL SAV vo Zvolene, Zvolene pp. 121-131. [RLL# 3 fig. 1 tab.]
AIR POLLUTION/ BIOINDICATORS/ HEAVY METALS/ SLOVAKIA/ SMELTER EMISSIONS
TLE

- Lackovicova, A 1995: Diverzita epifytickych lisajníkov v oblasti Krompách [Epiphytic lichen diversity in the Krompachy region]. - *Diverzita Rastlinstva Slovenska* **1995**: 158-163. [RLL# 166]
AIR POLLUTION/ BIOINDICATION/ HEAVY METALS/ SLOVAKIA
3 fig. [Study conducted in an area of Slovakia permanently influenced by heavy metal emissions.]

- Lambinon, J/ Maquinay, A/ Ramaut, JL 1964: La teneur en zinc de quelques lichens des terrains calaminaires belges. - *Bull. Jard. Bot. de l'Etat [Bruxelles]* **34(2)**: 273-282. [RLL# 51]
ZINC/ BELGIUM/ TERRICOLOUS/ HEAVY METALS
1 fig. [14 species.]

- Landers, DH/ Ford, J/ Gubala, C/ Monetti, M/ Lasorsa, BK/ Martinson, J 1995: Mercury in vegetation and lake sediments from the U.S. arctic. - *Water, Air, and Soil Pollution* **80**: 591-601. [RLL# 163]
AIR POLLUTION/ ARCTIC/ ELEMENT ANALYSIS/ HEAVY METALS/ MERCURY
3 fig. 1 tab. [Two mosses and two lichens (Masonhalea richardsonii and Cetraria cucullata) were used for analysis.]

- Lane, I/ Puckett, KJ 1979: Response of the phosphatase activity of the lichen Cladina rangiferina to various environmental factors including metals. - *Canadian Journal of Botany* **57**: 1534-1540. [RLL# 105-55]
CLADINA/ PHOSPHATASE/ ENZYME/ METAL IONS/ PH
5 figures. 6 tables. [Phosphatase activity was linear with increasing concentrations and time and showed highest activity at acidic pH. Enzyme activity was maximal in the range 61 +/-10 deg. C, was light independent, and was eliminated by boiling. Although copper, silver, and nickel ions increased activity, other tested cations and anions reduced activity.]

- Lawrey, JD 1977: Trace element accumulation by plant species from a coal strip-mining area in Ohio. - *Bull. Torrey Bot. Club* **104**: 368-375. [RLL# 99]
TRACE ELEMENTS/ AIR POLLUTION/ HEAVY METALS/ OHIO/ STRIP MINING
2 tables. [Includes data on 7 lichens.]

- Lawrey, JD 1993: Lichens as monitors of pollutant elements at permanent sites in Maryland and Virginia. - *The Bryologist* **96(3)**: 339-341. [RLL# 153]
AIR POLLUTION/ METALS/ NITROGEN/ SULFUR
4 tab. [Reports results of long-term air pollution studies using Flavoparmelia baltimorensis at three sites of increasing distance from urban Washington, D.C.]

- Lawrey, JD/ Rudolph, ED 1975: Lichen accumulation of some heavy metals from acidic surface substrates of coal mine ecosystems in southeastern Ohio. - *Ohio Jour. Sci.* **75**: 113-117. [RLL# 93-76]
HEAVY METALS/ OHIO/ AIR POLLUTION/ ACCUMULATION/ COAL MINES
3 tab.

• Lippo, H/ Poikolainen, J/ Kubin, E 1995: The use of moss, lichen and pine bark in the nationwide monitoring of atmospheric heavy metal deposition in Finland. - *Water, Air, and Soil Pollution* **85**: 2241-2246. [RLL# 164]
AIR POLLUTION/ ATMOSPHERIC DEPOSITION/ FINLAND/ HEAVY METALS
4 fig. 1 tab.

• Lodenius, M/ Kumpulainen, J 1983: Cd, Fe and Zn content of the epiphytic lichen Hypogymnia physodes in a Finnish suburb. - *Science of the Total Environment* **32**: 81-85. [RLL# 122-56]
HEAVY METALS/ FINLAND/ HYPOGYMNIA/ EPIPHYTES
2 figures. 1 table. [Helsinki suburb lichens had higher metal concentrations than samples from unpolluted areas.]

• Lodenius, M/ Laaksovirta, K 1979: Mercury content of Hypogymnia physodes and pine needles affected by a chlor-alkali works at Kuusankoski, SE Finland. - *Annales Botanici Fennici* **16**: 7-10. [RLL# 104-64]
MERCURY/ POLLUTION/ HYPOGYMNIA/ HEAVY METALS/ FINLAND
3 figures. ["The concentrations evenly decreased with increasing distance from the works and the effect of the works could be noticed in the whole study area (radius about 6 km) both in lichens and in needles."]

• Lokinskaia, MA 1968: On the element content in the ash of lichens. - *In:* : *Contributions III. Transcaucasian Conference on Sporogenous Plants. Published on the Occasion of the 50th Anniversary of the October Socialist Revolution*. . Institut Botaniki an Gruzinskoi SSR, Tbilisi. 285 pp pp. 246-250. [RLL# 75]
USSR/ ELEMENT CONTENT/ METALS
[In Russian.]

• Looney, JHH/ Webber, CE/ Nieboer, E/ Stetsko, PI/ Kershaw, KA 1986: Interrelationships between concentrations of 137Cs and various stable elements in three lichen species. - *Health Physics* **50**: 148-152. [RLL# 130]
137CS/ RADIONUCLIDES/ CANADA/ NORTHWEST TERRITORIES/ DACTYLINA/ CETRARIA/ HEAVY METALS
2 figures. 2 tables. [Studies were conducted in the Northwest Territories, Canada, with Cetraria nivalis, C. cucullata, and Dactylina arctica. "It is suggested that C. nivalis in particular and also D. arctica were enriched in particulates of larger relative dimensions whereas C. cucullata was best suited for particle size discrimination."]

• Loppi, S 1994: The amounts of Cd, Cr, Cu, Ni, Pb, and Zn in the Parmelia caperata growing in agricultural and suburban sites of the Pistoia area (central Italy) [Concentrazioni di Cd, Cr, Cu, Ni, Pb e Zn nel lichene Parmelia caperata, in località agricole e suburbane del Pistoiese (Italia centrale).]. - *Micologia e Vegetazione Mediterranea* **9(1)**: 25-34. [RLL# 158]
AGRICULTURE/ AIR POLLUTION/ BIOMONITORING/ HEAVY METALS/ ITALY
3 tab.

• Loppi, S/ Chiti, F/ Corsini, A/ Bernardi, L 1993: Lichen biomonitoring of trace metals in the Pistoia area (central northern Italy). - *Environmental Monitoring and Assessment* **29**: 17-27. [RLL# 155]
AIR POLLUTION/ BIOMONITORING/ HEAVY METALS/ TRACE METALS
5 fig. 2 tab.

• Loppi, S/ Corsini, A/ Bruscoli, C/ Rossetti, C 1995: Lichen biomonitoring of heavy metals in Montecatini Terme (central northern Italy) [Biomonitoraggio di metalli pesanti tramite licheni a Montecatini Terme (Italia Centro Settentrionale)]. - *Micologia e Vegetazione Mediterranea* **10(2)**: 122-128. [RLL# 165]
AIR POLLUTION/ BIOMONITORING/ ITALY/ TRACE ELEMENT ANALYSIS
2 fig. 2 tab. [Parmelia caperata is used as a bioaccumulator.]

• Loppi, S/ Pacioni, G/ Olivieri, N/ Di Giacomo, F 1998: Accumulation of trace metals in the lichen Evernia prunastri transplanted at biomonitoring sites in central Italy. - *The Bryologist* **101(3)**: 451-454. [RLL# 172]
BIOMONITORING/ EVERNIA/ ITALY/ TRACE METALS/ TRANSPLANTS
1 tab.

• Loppi, S/ Putortì, E/ Pirintsos, SA/ De Dominicis, V 2000: Accumulation of heavy metals in epiphytic lichens near a municipal solid waste incinerator (central Italy). - *Environmental Monitoring and Assessment* **61**: 361-371. [RLL# 181]
AIR POLLUTION/ BIOMONITORING/ EMISSIONS/ EPIPHYTIC/ HEAVY METALS/ INCINERATOR/ ITALY/ TRACE METALS
4 fig. 2 tab.

• Mankovska, B/ Kyselova, Z 1987: Obsah tazkych kovov v lisajnikoch z oblasti Tatranskeho narodneho parku. - *Biologia [Bratislava]* **42(9)**: 893-901. [RLL# 136]
CZECHOSLOVAKIA/ TATRA NATIONAL PARK/ CETRARIA/ CLADONIA/ UMBILICARIA/ AUTOMOBILES/ AIR POLLUTION/ HEAVY METALS
9 tables. [Study of heavy metals from automobile exhaust in the mountains of Tatra National Park, Czechoslovakia. Test ogranisms were Cetraria islandica, Cladonia rangiferina, and Umbilicaria deusta. In Slovak; English and Russian abstracts.]

• Maquinay, A/ Lamb, IM/ Lambinon, J/ Ramaut, JL 1961: Dosage du zinc chez un lichens calaminaire belge: Stereocaulon nanodes Tuck. f. tyroliense (Nyl.) M. Lamb. - *Physiol. Plantarum* **14**: 284-289. [RLL# 43]
ZINC/ STEREOCAULON/ BELGIUM/ HEAVY METALS/ ACCUMULATION/ SOILS
4 tab. [This taxon "confined in Belgium to calamine-bearing soils takes up zinc and in some cases accumulated it in the thallus. This lichen using as a substrate slag with 700 p.p.m. of zinc may contain up to 3300 p.p.m. Zn. This abnormally high content as compared with the usual plant tolerance for this element does not seem to disturb the metabolism."]

• Margot, J/ Ramain, MT 1976: Metaux lourds et cryptogames terrestres. Synthese bibliographie. - *Mem. Soc. Roy. Bot. Belgique* **7**: 25-47. [RLL# 96]
HEAVY METALS/ TERRICOLOUS/ BIBLIOGRAPHY
[128 referecnes.]

• Markert, B (ed.) 1993: *Plants as Biomonitors. Indicators for Heavy metals in the Terrestrial Environment*. - VCH, Weinheim. 644 pp. [RLL# 156]
AIR POLLUTION/ BIOINDICATION/ BIOMONITORING/ HEAVY METALS/ TERRESTRIAL VEGETATION
[Multi-author volume with 32 chapters, covering many topics. Five chapters deal in part or in whole with lichens (cited separately).]

• Markert, B 1998: Distribution and biogeochemistry of inorganic chemicals in the environment. - *In:* Schüürmann, G/Markert, B (eds.): *Ecotoxicology*. . John Wiley and Sons, Inc. & Spektrum Akademischer Verlag pp. 167-222. [RLL# 176]
BIOGEOCHEMISTRY/ ELEMENT ANALYSIS/ HEAVY METALS/ NITROGEN DEPOSITION
3 fig. 4 tab. 2 append.

• Markert, B/ Oehlmann, J/ Roth, M 1997: Biomonitoring von Schwermetallen - eine kritische Bestandsaufnahme. - *Zeitschrift für Ökologie und Naturschutz* **6**: 1-8. [RLL# 176]
AIR POLLUTION/ BIOMONITORING/ HEAVY METALS
3 fig. 2 tab.

• Markert, B/ Oehlmann, J/ Roth, M 1997: General aspects of heavy metal monitoring by plants and animals. - *In:* Subramanian, KS/Iyengar, GV (eds.): *Environmental Biomonitoring - Exposure Assessment and Specimen Banking*. . ACS Symposium Series, American Chemical Society, Washington, D. C. pp. 19-29. [RLL# 176]
BIOMONITORING/ HEAVY METALS/ POLLUTION
2 fig.

• Markert, B/ Wappelhorst, O/ Weckert, V/ Herpin, U/ Siewers, U/ Friese, K/ Breulmann, G 1999: The use of bioindicators for monitoring the heavy-metal status of the environment. - *Journal of Radioanalytical and Nuclear Chemistry* **240(2)**: 425-429. [RLL# 176]
BIOINDICATION/ BIOMONITORING/ HEAVY METALS
2 fig. 1 tab.

• Mattsson, LJS 1975: 137Cs in the reindeer lichen Cladonia alpestris: deposition, retention and internal distribution, 1961-1970. - *Health Phys.* **28**: 233-248. [RLL# 92-54]
RADIOISOTOPES/ RADIONUCLIDES/ AIR POLLUTION/ FALLOUT/ CLADONIA/ HEAVY METALS/ CAESIUM/ CS137
9 fig. 3 tab.

• Medvedev, N 1995: Concentrations of cadmium, lead and sulphur in tissues of wild, forest reindeer from north-west Russia. - *Environmental Pollution* **90(1)**: 1-5. [RLL# 166]
CADMIUM/ FORAGING/ HEAVY METALS/ LEAD/ REINDEER/ SULFUR
3 fig. 6 tab.

- Mhatre, GN 1991: Bioindicators and biomonitoring of heavy metals. - *Journal of Environmental Biology* **12**: 201-209. [RLL# 166]
AIR POLLUTION/ BIOINDICATORS/ HEAVY METALS
6 tab. [Brief mention of lichens and mosses.]

- Minger, A/ Krähenbühl, U 1997: Moss and lichen as biomonitors for heavy metals. - *International Journal of Environmental Analytical Chemistry* **67**: 41-48. [RLL# 172]
BIOMONITORING/ HEAVY METALS/ HYPOGYMNIA/ MOSSES
2 fig. 4 tab. [Comparison of Zn, Pb and Cd concentration in several mosses with Hypogymnia physodes.]

- Miszalski, Z/ Niewiadomska, E 1993: Comparison of sulphite oxidation mechanisms in three lichen species. - *New Phytologist* **123(2)**: 345-349. [RLL# 152]
AIR POLLUTION/ HEAVY METALS/ SULPHITE OXIDATION
2 fig. 3 tab. ["Three species of lichen: Hypogymnia physodes (L.) Nyl., Pseudevernia furfuracea (L.) Zopf and Usnea filipendula Stirt. with differing sensitivities to SO2 were examined for differences in their ability to carry out sulphite oxidation. The factor responsible for sulphite oxidation is not connected with the metabolic activity of thalli and probably the oxidation does not take place in reaction with O2-. The rate of sulphite oxidation may well depend on the content of heavy metals in the thalli."]

- Mocellin, G 1999: Bioaccumulo di metalli in licheni epifiti. - *Notiziario della Società Lichenologica Italiana* **12**: 95-97. [RLL# 179]
BIOMONITORING/ ITALY/ TRACE METALS
3 fig.

- Mueller, CS/ Thompson, RL/ Ramelow, GJ/ Beck, JN/ Langley, MP/ Young, JC 1987: Distribution of Al, V, and Mn in lichens across Calcasieu Parish, Louisiana. - *Water, Air, and Soil Pollution* **33**: 155-164. [RLL# 132]
AIR POLLUTION/ HEAVY METALS/ LOUISIANA/ RAMALINA
6 tables. 5 figures. [Study using Ramalina stenospora in southwestern Louisiana. "Metal concentration was found to decrease exponentially with distance outward from the industrial corridor. The major industries included were an Al plant, two refineries and five chemical plants mostly related to plastics production."]

- Mukherjee, AB/ Nuorteva, P 1994: Toxic metals in forest biota around the steel works of Rautaruukki Oy, Raahe, Finland. - *Science of the Total Environment* **151**: 191-204. [RLL# 166]
BIOINDICATORS/ FINLAND/ FOREST/ HEAVY METALS/ STEEL WORKS
8 fig. 7 tab.

- Nash, TH", III 1972: Simplification of the Blue Mountain lichen communities near a zinc factory. - *The Bryologist* **75**: 315-324. [RLL# 83]
ECOLOGY/ BLUE MOUNTAIN/ AIR POLLUTION/ ZINC/ HEAVY METALS
1 fig. 3 tab.

- Nash, TH", III 1989: Metal tolerance in lichens. - *In:* A. Jonathan Shaw (ed.): *Heavy Metal Tolerance in Plants: Evolutionary Aspects*. . CRC Press, Inc., Boca Raton pp. 119-131. [RLL# 140]
METAL POLLUTION/ HEAVY METALS TOLERANCE/ REVIEW
1 table. [Review with many references. "Perhaps with the rapid development of plant molecular biology and the recent successful demonstration of gene flow in lichens, the degree to which genetically based tolerance exists in lichens will become demonstrated in the future."]

- Nash, TH", III/ Sommerfeld, MR 1981: Elemental concentrations in lichens in the area of the Four Corners Power Plant, New Mexico. - *Environmental and Experimental Botany* **21**: 153-162. [RLL# 112-52]
NEW MEXICO/ HEAVY METALS/ AIR POLLUTION/ FLY ASH/ FLUORINE
3 tables. 1 figure. ["Within a several kilometre radius of the Four Corners Power Plant, lichen species had elevated concentrations of B, F, Li and Se compared with lichens of more remote sites. The elements Ba, Cu, Mn and Mo were found in elevated concentrations, but only in one lichen species. The patterns of elements occurring in both elevated and non-elevated levels correspond very closely to published chemical data on enrichment ratios and elemental solubility for post-precipitator fly ash. Within a 2 km radius F was found in concentrations potentially toxic to lichens."]

• Nash, TH, III/ Gries, C 1995: The response of lichens to atmospheric deposition with an emphasis on the Arctic. - *Science of the Total Environment* **160/161**: 737-747. [RLL# 158]
AIR POLLUTION/ ANATOMY/ ORGANOPOLLUTANTS/ OXIDANTS/ PHYSIOLOGY/ SULFUR DIOXIDE/ TRACE METALS
2 fig. [Review article.]

• Nieboer, E/ Ahmed, HM/ Puckett, KJ/ Richardson, DHS 1972: Heavy metal content of lichens in relations to distance from a nikel smelter in Sudbury, Ontario. - *Lichenologist* **5**: 292-304. [RLL# 84]
AIR POLLUTION/ HEAVY METALS/ SUDBURY/ ONTARIO/ CANADA/ ACCUMULATION
6 fig. 6 tab.

• Nieboer, E/ Puckett, KJ/ Grace, B 1976: The uptake of nickel by Umbilicaria muhlenbergii: a physiochemical process. - *Canad. Jour. Bot.* **54**: 724-733. [RLL# 94]
MINERAL UPTAKE/ UMBILICARIA/ PHYSIOLOGY/ NICKEL/ HEAVY METALS
6 fig. 9 tab.

• Nieboer, E/ Puckett, KJ/ Richardson, DHS/ Tomassini, FD/ Grace, B 1977: Ecological and physiological aspects of the accumulation of heavy metals and sulphur in lichens. - *In:* : *International Conference on Heavy Metals in the Environment, Toronto, Ontario, Canada, Oct. 27-31, 1975, Proceedings. Vol. 1. Part 1.* . pp. 331-351. [RLL# 100]
HEAVY METALS/ ECOLOGY/ PHYSIOLOGY/ ACCUMULATION/ SULFUR/ REVIEW
7 figures. 5 tables.

• Nieboer, E/ Richardson, DHS 1980: The replacement of the nondescript term 'heavy metals' by a biologically and chemically significant classification of metal ions. - *Environmental Pollution, Series B* **1**: 3-26. [RLL# 107-53]
HEAVY METALS/ TERMINOLOGY/ CLASSIFICATION
3 figures. 3 tables. ["It is proposed that the term 'heavy metals' be abandoned in favour of a classification which separates metal ions into class A (oxygen-seeking), class B (nItrogen/sulphur-seeking) and borderline (or intermediate)." Several of the authors' previous works on the effects of such metal ions on lichens are mentioned in the paper.]

• Nieboer, E/ Richardson, DHS/ Boileau, LJR/ Beckett, PJ/ Lavoie, P/ Padovan, D 1982: Lichens and mosses as monitors of industrial activity associated with uranium mining in northern Ontario, Canada--part 3: accumulation of iron and titanium and their mutual dependence. - *Environmental Pollution, Series B* **4**: 181-192. [RLL# 119-99]
HEAVY METALS/ POLLUTION/ URANIUM MINING/ ACCUMULATION/ IRON/ TITANIUM/ ONTARIO/ CANADA
6 figures. 2 tables. ["The various associations and observations reported were interpreted as evidence that particulate trapping is an important elemental accumulation mechanism for lichens and mosses."]

• Nimis, PL 1999: Linee-guida per l'utilizzo di licheni epifiti come bioaccumulatori di metalli in traccia. - *In:* Piccini, C/Salvati, S (eds.): *Atti del Workshop "Biomonitoraggio della qualità dell'aria: stato dell'arte in Italia"*. . Agenzia Nazionale per la Protezione dell'Ambiente, Rome pp. 279-289. [RLL# 179]
EPIPHYTES/ ITALY/ TRACE ELEMENT ANALYSIS/ TRACE ELEMENTS/ TRACE METALS
[Proceedings of a workshop on use of vascular plants, mosses, lichens, and a few other organisms in monitoring air pollution in Italy, held in Rome, 26-27 November 1998. This contribution presents a methodology for using epiphytic lichens to measure bioaccumulation of trace metals.]

• Nimis, PL/ Castello, M/ Perotti, M 1993: Lichens as Bioindicators of Heavy Metal Pollution: a Case Study at La Spezia (N Italy). - *In:* Markert, B (ed.): *Plants as Biomonitors. Indicators for Heavy Metals in the Terrestrial Environment*. . VCH, Weinheim pp. 264-284. [RLL# 156]
BIOINDICATORS/ HEAVY METALS/ ITALY/ POLLUTION
12 fig. 2 tab.

• Noeske, O/ Lauchili, A/ Lange, OL/ Vieweg, GH/ Ziegler, H 1970: Koncentration und Lokalisieruing von Schwermetallen in Flechten der Erzschlackenhalden des Harzes. - *Vortrage aus dem Gesamtegebiet der Botanik, N.F. [Deutsch. Bot. Ges.]* **4**: 67-79. [RLL# 75]
HEAVY METALS/ HISTOLOGY/ MORPHOLOGY/ AIR POLLUTION
4 fig. 7 tab. [The histological distribution of heavy metals in lichen tahlli.]

• Nyangababo, JT 1987: Lichens as monitors of aerial heavy metal pollutants in and around Kampala. - *Bulletin of Environmental Contamination and Toxicology* **38**: 91-95. [RLL# 132]

HEAVY METALS/ KAMPALA/ UGANDA/ AIR POLLUTION/ CALYRNEFERES
4 tables. [Air pollution study around Kampala, Uganda. "One type of lichen species (Calyrneferes usambaricum) was used as the test plant."]

- Nygard, S/ Harju, L 1983: A study of the short range pollution around a power plant using heavy fuel oil by analysing vanadium in lichens. - *Lichenologist* **15**: 89-93. [RLL# 117-67]
VANADIUM/ POLLUTION/ FUEL OIL/ HYPOGYMNIA/ FINLAND/ HEAVY METALS
2 figures. 1 table. [Study in southwestern Finland determined vanadium levels in Hypogymnia physodes. The highest concentrations of vanadium were found in lichens less than one km from the power plant.]

- Olech, M 1991: Preliminary observations on the content of heavy metals in thalli of Usnea antarctica Du Rietz (Lichenes) in the vicinity of the "H. Arctowski" Polish Antarctic Station. - *Polish Polar Research* **12(1)**: 129-131. [RLL# 156]
AIR POLLUTION/ ANTARCTIC/ HEAVY METALS/ USNEA
1 tab.

- Olmez, I/ Gulovali, MC/ Gordon, GE 1985: Trace element concentrations in lichens near a coal-fired power plant. - *Atmospheric Environment* **19**: 1663-1669. [RLL# 128-80]
AIR POLLUTION/ TRACE ELEMENTS/ METALS/ PARMELIA
4 figures. 1 table. [Study using Parmelia caperata and P. rudecta samples NW of Washington, DC. "No significant differences in concentrations were observed among lichens collected at various distances ranging from 1.6 to 20 km from the plant, suggesting that the effects of plume touchdown are small compared with normal ambient concentrations of particles."]

- Pakarinen, P 1981: Nutrient and trace metal content and retention in reindeer lichen carpets of Finnish ombotrophic bogs. - *Annales Botanici Fennici* **18**: 265-274. [RLL# 113-70]
FINLAND/ BOG/ CLADONIA/ HEAVY METAL/ NUTRIENT/ CATION EXCHANGE/ ECOLOGY/ ACCUMULATION/ UPTAKE
5 figures. 4 tables. [Macronutrients and trace metals were studied in Cladonia species from 23 bogs. "The concentrations of N, Fe, Zn, Pb, and Cu in Cladonia decreased towards the inland and northern sites, probably reflecting similar regional differences in the atmospheric fallout." The data also suggest that "... there is significant active uptake of the macronutrients P, N, and K, while Ca is primarily bound passively at the cation exchange sites and is only weakly retained by Cladonia." The author also found that "... iron and lead are concentrated in the dead basal parts, but postassium, nitrogen and phosphorus are chiefly accumulated in the living top part."]

- Pakarinen, P/ Makinen, A/ Rinne, RJK 1978: Heavy metals in Cladonia arbuscula and Cladonia mitis in eastern Fennoscandia. - *Annales Botanici Fennici* **15**: 281-286. [RLL# 103-68]
CLADONIA/ CLADINA/ HEAVY METALS/ FENNOSCANDIA/ FINLAND/ NORWAY/ GRADIENTS
2 tables. 2 figures. [Cu, Fe, Mn, Pb, and Zn were measured from 23 sites in Finland and northern Norway. Pb, Fe, Zn and Cu showed significant decrease from south to north. Vertical gradients within podetia were shown.]

- Pankhurst, CE/ Doube, BM/ Gupta, VVSR (eds.) 1997: *Biological Indicators of Soil Health*. - CAB International, Wallingford. 451 pp. [RLL# 176]
BIOINDICATION/ SOIL
[Review. At least three chapters include brief consideration of the role of lichens as indicators: Ch. 7, Soil microflora as bioindicators of soil health; Ch. 13, Biomonitoring of soil health by plants; Ch. 14, Bioindicators to detect contaminatin of soils with special reference to heavy metals.]

- Peer, T/ Türk, R 1991: Auswirkungen von Tunnelentlüftungssystemen auf den Schwermetallgehalt in Böden und Pflanzen am Beispiel der Tauernautobahn. - *Akademie für Naturschutz und Landschaftspflege* **1991**: 78-85. [RLL# 149]
AIR POLLUTION/ HEAVY METALS
4 fig. 7 tab.

- Pilegaard, K 1978: Airborn metals and SO2 monitored by epiphytic lichens in an industrail area. - *Environmental Pollution* **17**: 81-92. [RLL# 102-55]
AIR POLLUTION/ SO2/ EPIPHYTES/ LECANORA/ DENMARK/ HEAVY METALS
2 tables. 5 figures. [Lecanora conizaeoides was used to monitor 11 different metals and SO2 near an industrial area in Denmark. Heavy metals increase in the thallus up to about 3 km from the source. Because L. conizaeoides is SO2 tolerant, it

is an excellent biological monitor for these air pollutants.]

- Pilegaard, K 1994: Deposition of airborne metals around the lead-zinc mine in Maarmorilik monitored by lichens and mosses. - *Meddelelser om Gronland, Bioscience* **43**: 1-20. [RLL# 166]
AIR POLLUTION/ BIOMONITORING/ GREENLAND/ HEAVY METALS/ LEAD MINE
8 fig. 17 tab. ["The deposition of heavy metals around the PB-Zn mine in Maarmorilik (Greenland) was monitored during the years 1979-1990 by analyses of concentrations in in situ lichens (Cetraria nivalis and Umbilicaria lyngei) and higher plants (Rhododendron lapponicum)."]

- Poblet, A/ Andrade, S/ Scagliola, M/ Vodopivez, C/ Curtosi, A/ Pucci, A/ Marcovecchio, J 1997: The use of epilithic Antarctic lichens (Usnea aurantiacoatra and U. antarctica) to determine deposition patterns of heavy metals in the Shetland Islands, Antarctica. - *Science of the Total Environment* **207**: 187-194. [RLL# 171]
AIR POLLUTION/ ANTARCTIC/ BIOINDICATORS/ EPILITHIC/ HEAVY METALS
1 fig. 3 tab.

- Poliakov, IA/ Leont've, AM/ Mel'nikov, LK 1962: Contribution to Sr90 fallouts in the medium latitudes of the USSR. - *Pochvovedenie* **1962(11)**: 45-50. [RLL# 59]
USSR/ FALLOUT/ STRONTIUM/ SR90/ RADIONUCLIDES/ BIOINDICATION/ HEAVY METALS/ AIR POLLUTION
2 tab. [In Russian. "This paper deals with the role of mosses (Bryophyte) and lichens (Lichenes), as a source of Sr90 accumulation. Biochemical and morphological properties of these plants allow their use as reliable indicators for testing of a given area contamination with Sr90 and other radionuclides." --The entire English summary verbatim.]

- Puckett, KJ 1976: The effect of heavy metals on some aspects of lichen physiology. - *Canad. Jour. Bot.* **54**: 2695-2703. [RLL# 96]
HEAVY METALS/ PHYSIOLOGY/ AIR POLLUTION
7 figures. 5 tables.

- Puckett, KJ 1988: Bryophytes and lichens as monitors of metal deposition. - *In:* T. H. Nash, III & V. Wirth (eds.): *Lichens, Bryophytes and Air Quality*. . Bibliotheca Lichenologica No. 30. J. Cramer, Berlin-Stuttgart pp. 231-267. [RLL# 135]
HEAVY METALS/ AIR POLLUTION/ MONITORING
3 tables. ["The criteria for suitable biomonitors of metal deposition and to what extent bryophytes and lichens satisfy these criteria are addressed." The author also reviews factors determining choice of in situ monitors, use of transplanted material, techniques for source identification of the accumultated metals and substrate influences. "Lastly, spatial and temporal variation in metal deposition as the result of emissions from line, point, area and remote sources are summarized."]

- Purvis, OW 1996: Interactions of lichens with metals. - *Science Progress* **79(4)**: 283-309. [RLL# 168]
COPPER/ IRON/ METAL ACCUMULATION/ METAL UPTAKE/ METALS
9 fig. 2 tab. [Detailed review article.]

- Purvis, W/ Williamson, B/ Bartok, K/ Rusu, A-M/ Dubbin, B 1999: Accumulation of particulates (PM10's) by lichens in the vicinity of an ore processing plant, Zlatna, Romania. - *In:* Anon. (ed.): *International Conference on Lichen Conservation Biology, Licons*. . Swiss Federal Institute for Forest, Snow and Landscape Research, Birmensdorf, Switzerland pp. unpaginatedinsert. [RLL# 180]
HEAVY METALS/ LEAD/ MINING/ POLLUTION/ ROMANIA
[Abstract.]

- Pyatt, FB 1976: Lichen ecology of metal spoil tips: effects of metal ions on ascospore viability. - *The Bryologist* **79**: 172-179. [RLL# 95]
METAL SPOILS/ ASCOSPORE VIABILITY/ HEAVY METALS/ POLLUTION/ ECOLOGY
2 figures. 2 tables.

- Pyatt, FB/ Grattan, JP/ Lacy, D/ Pyatt, AJ/ Seaward, MRD 1999: Comparative effectiveness of Tillandsia usneoides L. and Parmotrema praesorediosum (Nyl.) Hale as bio-indicators of atmospheric pollution in Louisiana (U.S.A.). - *Water, Air, and Soil Pollution* **111(1-4)**: 317-326. [RLL# 176]
AGE/ BIOINDICATION/ ELEMENT ANALYSIS/ EPIPHYTES/ HEAVY METALS/ LOUISIANA/ USA
1 tab.

• Rao, DN/ Robitaille, G/ LeBlanc, F 1977: Influence of heavy metal pollution on lichens and bryophytes. - *Jour. Hattori Bot. Lab.* **42**: 213-239. [RLL# 100]
HEAVY METALS/ AIR POLLUTION/ REVIEW
10 tables.

• Rao, DN/ Robitaille, G/ LeBlanc, F 1977: Influence of heavy metal pollution on lichens and bryophytes. - *Jour. Hattori Bot. Lab.* **42**: 213-239. [RLL# 100]
HEAVY METALS/ AIR POLLUTION/ REVIEW
10 tables.

• Richardson, DHS 1988: Understanding the pollution sensitivity of lichens. - *Botanical Journal of the Linnean Society* **96(1)**: 31-43. [RLL# 136]
AIR POLLUTION/ REVIEW/ ACID RAIN/ ACCUMULATION
["This review summarizes the effects of the various components of air pollution including metals, sulphur dioxide and acid rain. The mechanisms leading to accumulation of elements by lichens or indication of damage by air pollutants are discussed."]

• Richardson, DHS/ Neiboer, E 1983: The uptake of nickel ions by lichen thalli of the genera Umbilicaria and Peltigera. - *Lichenologist* **15**: 81-88. [RLL# 117-78]
NICKEL/ HEAVY METALS/ UMBILICARIA/ PELTIGERA/ ACCUMULATION/ UPTAKE/ POLLUTION
5 tables. ["By using a dissection technique it was demonstrated that binding of Ni2+ ions occurred to both the algal zone and fungal medulla in various species of the lichen genus Umbilicaria." Uptake by Peltigera was considerably greater than Umbilicaria.]

• Richardson, DHS/ Nieboer, E 1980: Surface binding and accumulation of metals in lichens. - *In:* C. B. Cook, P. W Pappas & E. D. Rudolph (eds.): *Cellular Interactions in Symbiosis and Parasitism*. . Ohio State University Press, Columbus pp. 75-94. [RLL# 107-66]
SYMBIOSIS/ SURFACE BINDING/ METAL ACCUMULATION
6 figures. 1 table. [Review with many referecnes.]

• Richardson, DHS 1991: Lichens as biological indicators - recent developments. - *In:* Jeffrey, DW/Madden, B (eds.): *Bioindicators and Environmental Management*. . Academic Press, London, San Diego pp. 263-272. [RLL# 159]
ACID RAIN/ AIR POLLUTION/ BIOINDICATION/ METAL POLLUTION/ PCB/ RADIONUCLIDES/ SO2

• Riga-Karandinos, AN/ Karandinos, MG 1998: Assessment of air pollution from a lignite power plant in the plain of Megalopolis (Greece) using as biomonitors three species of lichens; impacts on some biochemical parameters of lichens. - *Science of the Total Environment* **215**: 167-183. [RLL# 172]
AIR POLLUTION/ BIOMONITORING/ CHLOROPHYLL DEGRADATION/ GREECE/ LIGNITE/ METALS/ POWER PLANTS/ PROTEINS/ SULFUR
2 fig. 6 tab.

• Rodrigo, A/ Avila, A/ Gómez-Bolea, A 1999: Trace metal contents in Parmelia caperata (L.) Ach. compared to bulk deposition, throughfall and leaf-wash fluxes in two holm oak forests in Montseny (NE Spain). - *Atmospheric Environment* **33**: 359-367. [RLL# 175]
ATMOSPHERIC DEPOSITION/ DEPOSITION/ MINERAL CYCLING/ QUERCUS/ THROUGHFALL/ TRACE METALS
2 fig. 3 tab.

• Ronen, R/ Garty, J/ Galun, M 1983: Air pollution monitored by lichens. - *Proceedings of the International Meeting of the Israel Ecological Society, Jerusalem, May, 1983 [Developments in Ecology and Environmental Quality]* **2**: 167-176. [RLL# 122-79]
AIR POLLUTION/ CHLOROPHYLL/ SULFUR CONTENT/ HEAVY METALS/ ISRAEL/ TRANSPLANTS/ OWN
1 figure. 2 tables. [Transplants of Ramalina duriaei were tested for chlorophyll degradation. "No significant correlation was found between the content of total sulphur in the lichen and chlorophyll degradation. Correlations between chlorophyll degradation and the content of some chemical elements are suggested as being useful in interpreting the impact of air pollution on lichens."]

• Saeki, M/ Kunii, K/ Seki, T/ Sugiyama, K/ Suzuki, T/ Shishido, S 1977: Metal burden of urban lichens. - *Environm. Res.* **13**: 256-266. [RLL# 97]
HEAVY METALS/ JAPAN/ SENDAI/ POLLUTION
11 tbales. 3 figures. [Study in Sendai, Japan.]

• Saeki, M/ Kunii, K/ Seki, T/ Suzuki, T 1975: A lichen (Parmelia conspersa) surviving with elevated concentrations of lead and copper in the center of Sendai City. - *Bull. Environm. Contam. Toxicol.* **14**: 726-730. [RLL# 100]
COPPER/ LEAD/ JAPAN/ SENDAI CITY/ HEAVY METALS/ PARMELIA/ XANTHOPARMELIA/ AIR POLLUTION
2 figures.

• Sarkela, M/ Nuorteva, P 1987: Levels of aluminium, iron, zinc, cadmium and mercury in some indicator plants growing in unpolluted Finnish Lapland. - *Annales Botanici Fennici* **24**: 301-305. [RLL# 134]
POLLUTION/ HEAVY METALS/ FINLAND/ LAPLAND/ HYPOGYMNIA/ ALUMINUM/ CADMIUM/ IRON/ ZINC/ MERCURY
1 figure. 3 tables. [Hypogymnia physodes was one of the plants tested.]

• Sarret, G/ Manceau, A/ Cuny, D/ Van Haluwyn, C/ Déruelle, S/ Hazemann, J-L/ Soldo, Y/ Eybert-Bérard, L/ Menthonnex, J-J 1998: Mechanisms of lichen resistance to metallic pollution. - *Environmental Science & Technology* **32**: 3325-3330. [RLL# 174]
HEAVY METALS TOLERANCE/ METAL ACCUMULATION/ METAL POLLUTION/ POLLUTION
4 fig. 1 tab. [Study of Pb and Zn in Diploschistes muscorum and of Pb in Xanthoria parietina.]

• Sarret, G/ Manceau, A/ Spadini, L/ Roux, J-C/ Hazemann, J-L/ Soldo, Y/ Eybert-Bérard, L/ Menthonnex, J-J 1998: Structural determination of Zn and Pb binding sites in Penicillium chrysogenum cell walls by EXAFS spectroscopy. - *Environmental Science & Technology* **32**: 1648-1655. [RLL# 174]
HEAVY METALS TOLERANCE/ METAL ACCUMULATION/ METAL POLLUTION/ POLLUTION
5 fig. 1 tab. [Work with a non-lichenized fungus, but with data pertinent to the preceding paper by the same first author.]

• Sawidis, T/ Marnasidis, A/ Zachariadis, G/ Stratis, J 1995: A study of air pollution with heavy metals in Thessaloniki city (Greece) using trees as biological indicators. - *Archives of Environmental Contamination and Toxicology* **28(1)**: 118-124. [RLL# 166]
AIR POLLUTION/ GREECE/ HEAVY METALS
3 fig. 5 tab. [Comparisons are made with lichen data.]

• Schade, A 1933: Das Acarosporetum sinopicae als Charaktermerkmal der Flechtenflora sächsischer Bergwerkshalden. - */ Abh. d. naturwiss. Ges. Isis Dresden* **1932**: 131-160. [Mattick 22123]
GERMANY/ METALS/ MINE SPOILS

• Schade, A 1935: Ergänzende Beobachtungen über das Acarosporetum sinopicae der sächsischen Bergwerkshalden. - */ Abh. d. naturwiss. Ges. Isis Dresden* **1933/ 34**: 77-81. [Mattick 22124]
GERMANY/ METALS/ MINE SPOILS

• Schimwell, DW/ Laurie, AE 1972: Lead and zinc contamination of vegetation in the southern Pennines. - *Environm. Pollut.* **3**: 291-301. [RLL# 97]
BRITISH ISLES/ PENNINES/ LEAD/ ZINC/ HEAVY METALS/ POLLUTION
2 figures. 2 tables. [Includes lichens and mossses.]

• Schutte, JA 1977: Chromium in two corticolous lichens from Ohio and West Virginia. - *The Bryologist* **80**: 279-283. [RLL# 98]
CHROMIUM/ HEAVY METALS/ OHIO/ WEST VIRGINIA/ POLLUTION/ CORTICOLOUS/ EPIPHYTES
1 figure. 2 tables.

• Schwartzman, D/ Kasim, M/ Stieff, L/ Johnson, JH", Jr 1987: Quantitative monitoring of airborne lead pollution by a foliose lichen. - *Water, Air, and Soil Pollution* **32**: 363-378. [RLL# 132]
AIR POLLUTION/ LEAD/ PSEUDOPARMELIA/ MARYLAND/ VIRGINIA/ ION EXCAHNGE/ BIOMONITORING
6 tables. 5 figures. [Test organism was Pseudoparmelia baltimorensis for this study in the Washington, D.C. area. "The retention of heavy metals is consistent with trapping by an ion exchange mechanism."]

- Seaward, MRD 1974: Some observations on heavy metal toxicity and tolerance in lichens. - *Lichenologist* **6**: 158-164. [RLL# 91]
TOXICITY / TOLERANCE / HEAVY METALS / POLLUTION

- Seaward, MRD 1977: Metal levels in lichens: a correction. - *Lichenologist* **9**: 87. [RLL# 97]
HEAVY METALS/ POLLUTION

- Seaward, MRD 1995: Use and abuse of heavy metal bioassays in environmental monitoring. - *Science of the Total Environment* **176**: 129-134. [RLL# 162]
BIOINDICATORS/ HEAVY METALS/ POLLUTION/ TOXICITY
["Bioassays have often been ineffectual in environmental monitoring due to difficulties in communication, taxonomy, performance indicators, time-scale, consistency of habitat and standardization of techniques and expression of results."]

- Seaward, MRD 1997: Use and abuse of heavy metal bioassays of lichens in cases of heavy metal pollution monitoring. - *J. Bot. Soc. Bot. Fr.* **1**: 53-55. [RLL# 167]
AIR POLLUTION/ BIOASSAY/ BIOINDICATION/ HEAVY METALS
[A non-specific critique with suggestions.]

- Seaward, MRD/ Bylinska, EA 1980: Plant-substrate correlations in bioindication studies of metals. - *In:* R. Schubert & J. Schuh (eds.): *Methodische und theoretische Grundlagen der Bioindikation*. . Martin-Luther-Universitat, Halle-Wittenberg pp. 45-51. [RLL# 109-92]
METAL UPTAKE/ SOIL/ ACCUMULATION
5 tables. ["It is clear from our initial analyses that although high concentrations within the plant often broadly reflect high concentrations in the associated substrate, bioassay monitoring is qualitative since we have been unable to detect any significant mathematical correlation between a plant's uptake and a range of soils with known elemental contents.":]

- Seaward, MRD/ Bylinska, EA/ Goyal, R 1981: Heavy metal content of Umbilicaria species from the Sudety region of SW Poland. - *Oikos* **36**: 107-113. [RLL# 109-93]
POLAND/ UMBILICARIA/ HEAVY METALS/ AIR POLLUTION
5 tables. 1 figure. ["In general, the levels in the lichen thalli are indicative of background rather than enhanced concentrations in the substrata. At one site, however, the measurements reflect local atmospheric contamination." Seven Umbilicaria species were studied at 15 sites.]

- Seaward, MRD 1983: [*Review of:*] M. H. Martin & P. J. Coughtrey: Biological Monitoring of Heavy metal pollution. Land and Air. Applied Science Publishers, London and New York. 1982. - *Lichenologist* **15**: 212. [RLL# 119-115]
REVIEW
- Seaward, MRD/ Bylinska, EA/ Topham, PB 1983: The distribution and ecology of Umbilicaria propagulifera (Vainio) Llano. - *Nova Hedwigia* **38**: 703-716. [RLL# 120-115]
UMBILICARIA/ OWN/ POLAND/ DISTRIBUTION/ HEAVY METALS
1 table. 2 plates. [Discussion of the ecology of Umbilicaria propagulifera and recent discovery of this taxon at two sites in Poland is reported. Also included are notes on the abundance of certain heavy metals in the substrates of the Polish localities.]

- Seaward, MRD/ Goyal, R/ Bylinska, EA 1978: Heavy metal content of some terricolous lichens from mineral-enriched sites in northern England. - *Naturalist, Hull* **103**: 135-141. [RLL# 105-75]
BRITISH ISLES/ HEAVY METALS/ SOIL
1 figure. 3 tables. ["There are no direct correlations, from the data so far assembled (from a limited number of sites), between the heavy metal concentration within the lichen and that in the associated soil for any of the seven species studied."]

- Seaward, MRD/ Richardson, DHS 1989: Atmospheric sources of metal pollution and effects on vegetation. - *In:* A. Jonathan Shaw (ed.): *Heavy Metal Tolerance in Plants: Evolutionary Aspects*. . CRC Press, Inc., Boca Raton pp. 75-92. [RLL# 140]
METAL POLLUTION/ HEAVY METALS/ INDUSTRY/ REVIEW
1 table. [Review of sources of metal pollution and mechanisms of dispersal and deposition. "The sources of aerial metal contamination are numerous and only limited efforts are being directed at reducing the level of such pollution even among advanced industrial nations." Paper includes 156 references.]

• Shaw, JA (ed.) 1989: *Heavy Metal Tolerance in Plants: Evolutionary Aspects*. - CRC Press, Boca Raton, Florida. 355 pp. [RLL#]
AIR POLLUTION/ HEAVY METALS

• Sheppard, MI/ Thibault, DH 1984: Natural uranium concentrations of native plants over a low-grade ore body. - *Canadian Journal of Botany* **62**: 1069-1075. [RLL# 121-85]
URANIUM/ UMBILICARIA/ CLADONIA/ HEAVY METALS/ CANADA/ MANITOBA
6 tables. 3 figures. [Umbilicaria and Cladonia spp. were used in the study conducted in Manitoba, Canada. The plant concentrations did reflect the substrate concentrations. No seasonal changes were noted.]

• Showman, RE/ Hendricks, JC 1989: Trace element content of Flavoparmelia caperata (L.) Hale due to industrial emissions. - *JAPCA, Journal of the Air Pollution Control Association* **39**: 317-320. [RLL# 137]
AIR POLLUTION/ NEUTRON ACTIVATION/ CERIUM/ CHROMIUM/ TITANIUM/ ARSENIC/ COBALT/ LANTHANUM/ WEST VIRGINIA/ OHIO/ FLAVOPARMELIA/ HEAVY METALS
1 table. 4 figures. ["Trace element concentrations of the lichen, Flavoparmelia caperata, were determined by neutron activation analysis before and after stringent particulate controls were employed in an industrialized section of the Ohio River Valley." The study looked at levels of arsenic, cobalt, iron, vanadium, titanium, cerium, chromium, and lanthanum. "A repeat study in 1987 demonstrated that lichen trace element concentrations were much lower after improved particulate controls were installed on the power plants and ferro-alloys foundry."]

• Siegel, BZ/ Siegel, SM 1976: Unusual mercury accumulation in lichen flora of Montenegro. - *Waater, Air Soil Pollut.* **5**: 335-337. [RLL# 100]
MERCURY/ MONTENEGRO/ ACCUMULATION/ POLLUTION/ HEAVY METALS
1 figure. 2 tables.

• Simkin, J 1999: Small ecological project report: A survey of heavy metal contaminated sites in the North Pennines. - *British Lichen Society Bulletin* **85**: 29-30. [RLL# 178]
HEAVY METALS/ LEAD/ MINE SPOILS/ MINING/ ZINC
[Study of lichens in a historical lead/zinc mining area.]

• Solberg, Y/ Selmer-Olsen, AR 1978: Studies on the chemistry of lichens and mosses. XVII. Mercury content of several lichen and moss species collected in Norway. - *The Bryologist* **81**: 144-149. [RLL# 100]
NORWAY/ MERCURY/ CHEMISTRY/ HEAVY METALS
2 tables.

• Solberg, YJ 1967: Studies on the chemistry of lichens IV. The chemical composition of some Norwegian lichen species. - *Ann. Bot. Fenn.* **1**: 29-34. [RLL# 65]
NORWAY/ CHEMISTRY/ PROTEIN/ FIBER/ ASH/ METALS
1 fig. 4 tab. ["Qualitative analyses of protein, crude fibre, ash, phosphorus, sulphur, boron, managanese, calcium, magnesium, postassium and sodium have been performed in 45 Norwegian lichen species."]

• Steinnes, E 1995: Heavy metal contaminatin of the terrestrial environment in the border area between Russia and Norway - some recent results. - *In:* Lobersli, E/Venn, K (eds.): *Effects of Air Pollutants on Terrestrial Ecosystems in the Border Area Between Norway and Russia*. . Directorate for Nature Management, Trondheim pp. 68-71. [RLL# 168]
AIR POLLUTION/ HEAVY METALS/ METAL CONTENT/ NORWAY/ RUSSIA/ SCANDINAVIA
5 fig. 2 tab. [Lichens were among the tested plant materials.]

• Steinnes, E/ Krog, H 1977: Mercury, aresenic and selenium fall-out from an industrial complex studied by means of lichen transplants. - *Oikos* **28**: 160-164. [RLL# 99]
MERCURY/ ARSENIC/ HEAVY METALS/ TRANSPLANTS/ AIR POLLUTION/ ECOLOGY
5 figures. 1 table.

• Steubing, L/ Vogel, A 1998: Biomonitoring von Immissionswirkungen durch verkehrsbedingte Schwermetalle in einem Heideökosystem [Biomonitoring of heavy metal emissions related to traffic in a heathland ecosystem]. - *Umweltwissenschaften und Schadstoff Forschung* **10(6)**: 333-338. [RLL# 176]
ANTIMONY/ AUTOMOBILE EXHAUST/ BIOMONITORING/ CADMIUM/ HEATHLAND/ HEAVY METALS/ LEAD
4 fig. [Includes a few lichens and mosses.]

• Subbotina, EN/ Timofeev-Resovskii, NV 1961: The accumulation of some dispersal elements in water solutions by crustose lichens. - *Bot. Zhurn.* **46(2)**: 212-221. [RLL# 47]
HEAVY METALS/ ACCUMULATION/ CRUSTOSE/ ISOTOPES/ RADIOACTIVE
2 fig. 5 tab. [Accumulation of radioactive isotopes of S, Fe, Co, Zn, Sr, Ru, Cs, and Ce by a crustose lichen.]

• Svoboda, J/ Taylor, HW 1979: Persistence of cesium-137 in arctic lichens, Dryas integrifolia, and lake sediments. - *Arctic and Alpine Research* **11**: 95-108. [RLL# 104-105]
CESIUM/ ARCTIC/ HEAVY METALS/ VERMONT/ ISOTOPES/ FALLOUT
4 figures. 2 tables. [Seven different macrolichens from the Canadian arctic and Jay Peak, Vermont, were tested for caesium-137. Temperate lichens actually had higher levels than the arctic ones.]

• Takács, Z/ Csintalan, Z/ Tuba, Z 1999: Responses of the lichen Cladonia convoluta to high CO2 level and heavy metal treatment. - *Zeitschrift für Naturforschung, Sect. C* **54**: 797-801. [RLL# 179]
CADMIUM/ CLADONIA/ CO2 CONCENTRATION/ FLUORESCENCE/ HEAVY METALS/ LEAD/ PHOTOSYSTEM II/ RESPIRATION
1 fig. 1 tab.

• Takala, K/ Olkkonen, H/ Salminen, R 1994: Iron content and its relations to the sulphur and titanium contents of epiphytic and terricoloous lichens and pine bark in Finland. - *Environmental Pollution* **84(2)**: 131-138. [RLL# 155]
AIR POLLUTION/ BIOINDICATORS/ ELEMENT RATIOS/ GEOCHEMISTRY/ HEAVY METALS
5 fig. 7 tab. [Study using Hypogymnia physodes, Pseudevernia furfuracea, Peltigera aphthosa, and Cladina sp.]

• Tarazona Lafarga, T/ González Bueno, A/ Salas Muñoz, A/ Calvo Haro, R 1994: Análisis del comportamiento de detectores fisicos y biológicos de la contaminación atmosférica por metales pesados en el area industrial de Madrid. - *Studia Botanica* **13**: 147-150. [RLL# 166]
AIR POLLUTION/ HEAVY METALS/ MADRID/ SPAIN/ TRANSPLANTS
1 tab. [Transplant experiments using lichens to measure heavy metal deposition.]

• Tarhanen, S 1998: Ultrastructural responses of the lichen Bryoria fuscescens to simulated acid rain and heavy metal deposition. - *Annals of Botany* **82**: 735-746. [RLL# 174]
ACID RAIN/ AIR POLLUTION/ BRYORIA/ CU/ EM/ HEAVY METALS/ NI/ ULTRASTRUCTURE
5 fig. 3 tab.

• Tarhanen, S/ Metsärinne, S/ Holopainen, T/ Oksanen, J 1999: Membrane permeability response of lichen Bryoria fuscescens to wet deposited heavy metals and acid rain. - *Environmental Pollution* **104**: 121-129. [RLL# 174]
ACID RAIN/ AIR POLLUTION/ BRYORIA/ CU/ HEAVY METALS/ MEMBRANE PERMEABILITY/ NI
5 fig. 6 tab.

• Thomson, RL/ Ramelow, GJ/ Beck, JN/ Langley, MP/ Young, JC 1987: A study of airborne metals in Calcasieu Parish, Louisiana using the lichens, Parmelia praesorediosa and Ramalina stenospora. - *Water, Air, and Soil Pollution* **36(3-4)**: 295-309. [RLL# 143]
AIR POLLUTION/ PARMELIA/ PARMOTREMA/ LOUISIANA/ HEAVY METALS
9 figures. 9 tables. ["The data could be separated into two geographical areas that were statistically different. Highest concentrations were observed within a 10.8-km radius of the industrial/urban zone."]

• Thor, G 1993: The lichen flora in the former shipyard Eriksbergsvarvet, Göteborg, Sweden. - *Graphis Scripta* **5(2)**: 77-84. [RLL# 154]
CONCRETE/ SHIPYARDS/ SOIL/ SWEDEN/ WOOD
1 fig. [A total of 59 species is reported from old wooden quays, concrete, and soil heavily intermingled with metals. New to Sweden: Sarcopyrenia gibba, Vezdaea leprosa.]

• Tomassini, FD/ Puckett, KJ/ Nieboer, E/ Richardson, DHS/ Grace, B 1976: Determination of copper, iron, nickel, and sulphur by X-ray fluorescence in lichens from the Mackenzie Valley, Northwest Territories, and the Sudbury District, Ontario. - *Canad. Jour. Bot.* **54**: 1591-1603. [RLL# 95]
CANADA/ NORTHWEST TERRITORIES/ ONTARIO/ HEAVY METALS/ AIR POLLUTION/ X-RAY FLUORESCENCE/ TECHNIQUES
2 figures. 9 tables.

• Triscari, M/ Dongarrà, G/ Ottonello, D/ Sabation, G 1994: Differenziazione minerogenetiche rilevate mediante licheni bioaccumulatori. - *Atti Accademia Peloritana dei Pericolanti Classe I di Scienze Fis. Mat. e Nat.* **72**: 401-419. [RLL# 166]
BIOGEOCHEMISTRY/ HEAVY METALS/ PROSPECTING/ SICILY
7 fig. 2 tab.

• Tuba, Z/ Csintalan, Z 1993: Bioindication of Road Motor Traffic Caused Heavy Metal Pollution by Lichen Transplants. - *In:* Markert, B (ed.): *Plants as Biomonitors. Indicators for Heavy Metals in the Terrestrial Environment*. . VCH, Weinheim pp. 329-341. [RLL# 156]
BIOINDICATORS/ BIOMONITORING/ HEAVY METALS/ HUNGARY/ POLLUTION
10 fig. [Study conducted in Hungary, using Cladonia convoluta.]

• Tyler, G 1989: Uptake, retention and toxicity of heavy metals in lichens. A brief review. - *Water, Air, and Soil Pollution* **47(3-4)**: 321-333. [RLL# 143]
HEAVY METALS/ UPTAKE/ RETENTION/ REVIEW/ PHYSIOLOGY
4 tables. [A general review with many references.]

• Tyler, G/ Pahlsson, AMB/ Bengtsson, G/ Baath, E/ Tranvik, L 1989: Heavy metal ecology of terrestrial plants, microorganisms and invertebrates. A review. - *Water, Air, and Soil Pollution* **47(3-4)**: 189-215. [RLL# 143]
HEAVY METALS/ REVIEW
4 tables. [A general review with many references.]

• Upreti, DK/ Pandev, V 1994: Heavy metals of Antarctic lichens. 1. Umbilicaria. - *Feddes Repertorium* **105(3-4)**: 197-199. [RLL# 159]
AIR POLLUTION/ ANTARCTIC/ HEAVY METALS/ UMBILICARIA
1 tab. [Study of iron, copper, lead, and chromium levels in Umbilicaria aprina and U. decussata.]

• Upreti, DK/ Pandey, V 2000: Determination of heavy metals in lichens growing on different ecological habitats in Schirmacher Oasis, East Antarctica. - *Spectroscopy Letters* **33(3)**: 435-444. [RLL# 180]
ACCUMULATION/ AIR POLLUTION/ ANTARCTICA/ HEAVY METALS
1 fig. 2 tab.

• Vincent, JP 1994: La contamination de la végétation d'un environnement urbain par les métaux lourds [Heavy metals analysis in plants as an indicator of urban pollution]. - *Bulletin de la Société d'Histoire Naturelle de Toulouse* **130**: 27-32. [RLL# 164]
AIR POLLUTION/ HEAVY METALS
6 fig. 3 tab. 2 photo.

• Wadleigh, MA 1996: The Arctic atmosphere: sulphur and trace metals. - *Geoscience Canada* **23(4)**: 237-244. [RLL# 171]
AIR POLLUTION/ ARCTIC/ SULFUR
4 fig. 4 tab.

• Walther, DA/ Ramelow, GJ/ Beck, JN/ Young, JC/ Callahan, JD/ Marcon, MF 1990: Distributions of airborne heavy metals as measured in the lichens Ramalina stenospora and Parmotrema praesorediosum in Baton Rouge, Louisiana. - *Water, Air, and Soil Pollution* **50(3-4)**: 279-292. [RLL# 143]
BATON ROUGE/ PARMOTREMA/ RAMALINA/ AIR POLLUTION/ HEAVY METALS/ LOUISIANA
9 figures. 5 tables. ["Average metal concentrations for the two lichen species were used to construct contours and three-dimensional plots of metal distribution across the study area which clearly demonstrate the effects of the industrial zone on airborne metal levels."]

• Walther, DA/ Ramelow, GJ/ Beck, JN/ Young, JC/ Callahan, JD/ Marcon, MF 1990: Temporal changes in metal levels of the lichens Parmotrema praesorediosum and Ramalina stenospora, southwest Louisiana. - *Water, Air, and Soil Pollution* **53(1-2)**: 189-200. [RLL# 143]
AIR POLLUTION/ LOUISIANA/ PARMOTREMA/ RAMALINA/ TEMPORAL CHANGES/ HEAVY METALS
9 figures. 1 table. [Authors document a decline in airborne metal levels over a 5-year period. "The effects of the industrial zone, which was previously demonstrated, have now all but disappeared."]

• Wells, JM/ Brown, DH/ Beckett, RP 1995: Kinetic analysis of Cd uptake in Cd-tolerant and intolerant populations of the moss Rhytidiadelphus squarrosus (Hedw.) Warnst and the lichen Peltigera membranacea (Ach.) Nyl. - *New Phytologist*

129(3): 477-486. [RLL# 159]
CADMIUM/ HEAVY METALS TOLERANCE/ KINETICS/ PELTIGERA
3 fig. 7 tab.

- Wells, JM/ Brown, DH/ Beckett, RP 1995: Kinetic analysis of Cd uptake in Cd-tolerant and intolerant populations of the mosss Rhytidiadelphus squarrosus (Hedw.) Warnst and the lichen Peltigera membranacea (Ach.) Nyl. - *New Phytologist* **129(3)**: 477-486. [RLL# 160]
CADMIUM/ HEAVY METALS TOLERANCE/ KINETICS/ PELTIGERA
3 fig. 7 tab.

- Yevseev, AV/ Krasovskaya, TM 1994: Spatial and temporal patterns in pollutant accumulation in the ecosystems of the Kola Peninsula. - *Aquilo, Ser. Bot.* **34**: 65-68. [RLL# 162]
COPPER/ HEAVY METALS/ NICKEL/ RUSSIA/ STRONTIUM/ USSR
4 fig. 1 tab. [Study of copper, nickel, and strontium concentration in lichens and mosses.]

Recent Literature on Lichens and Mattick's Card Index

ORGANIC POLLUTANTS

Search criteria (word match - sorted on author):
Data set(s): RLL + Mattick + Supplement
Text string in title, keywords, or abstract: PAH, chlorinated hydrocarbons, organochlorine, PCB
Period: 1875 - 2001

- Bacci, E/ Calamari, D/ Gaggi, C/ Fanelli, R/ Focardi, S/ Morosini, M 1986: chlorinated hydrocarbons in lichen and moss samples from the Antarctic Peninsula. - *Chemosphere* **15**: 747-754. [RLL# 132]
CHLORINATED HYDROCARBONS/ ANTARCTICA/ POLLUTION
1 table. 2 figures. ["These preliminary results confirm that in the Antarctic Peninsula chlorinated hydrocarbon residues are present in measurable concentrations in biological materials."]

- Calamari, D/ Bacci, E/ Focardi, S/ Gaggi, C/ Morosini, M/ Vighi, M 1991: Role of plant biomass in the global environmental partitioning of chlorinated hydrocarbons. - *Environmental Science & Technology* **25(8)**: 1489-1495. [RLL#]
CHLORINATED HYDROCARBONS/ POLLUTION
8 fig. 4 tab. [Three hundred samples of plant tissue collected from 26 widespread localities around the world were tested for chlorinated hydrocarbons. In cold and temperate regions and at high elevations, (unidentified) lichens and mosses were sampled, and in tropical areas mango leaves were sampled.]

- Carlberg, GE/ Ofstad, EB/ Drangsholt, H/ Steinnes, E 1983: Atmospheric deposition of organic micropollutants in Norway studied by means of moss and lichen analysis. - *Chemosphere* **12**: 341-356. [RLL# 123-15]
AIR POLLUTION/ CLORINATED HYDORCARBONS/ NORWAY/ OWN/ ALKANES
5 figures. 2 tables. ["Lichen and moss have been found to reflect the pollution distribution in air better than biological samples like fish where many of the compounds are metabolized. The results from this investigation show that lichen may be well suited for monitoring the atmospheric deposition of chlorinated organics also in areas lacking major sources." The lichens were also found to be good monitors of PAH and phthalates but not for alkane monitoring.]

- Elkin, BT/ Bethke, RW 1995: Environmental contaminants in caribou in the Northwest Territories, Canada. - *Science of the Total Environment* **160/161**: 307-321. [RLL# 163]
AIR POLLUTION/ CANADA/ CARIBOU/ NORTHWEST TERRITORIES/ ORGANOCHLORINE/ POLYCHLORINATED BIPHENYLS/ RADIONUCLIDES/ RANGIFER
7 fig. 4 tab.

- Garty, J/ Perry, AS/ Mozel, J 1982: Accumulation of polychlorinated biphenyls (PCBs) in the transplanted lichen Ramalina duriaei in air quality biomonitoring experiments. - *Nordic Journal of Botany* **2**: 583-586. [RLL# 122-30]
AIR POLLUTION/ PCB/ RAMALINA/ TRANSPLANTS/ ISRAEL
1 table. 2 figures. ["Highest PCB values were found in lichens located at busy road intersections, where traffic is ordinarily heavy, while lower amounts of 1.0 ppm or less were characteristic of lichens located at sites removed from traffic or in more isolated agricultural areas." The study was conducted in Israel.]

• Morosini, M/ Schreitmüller, J/ Reuter, U/ Ballschmiter, K 1993: Correlation between C-6/C-14 chlorinated hydrocarbons levels in the vegetation and in the boundary layer of the troposphere. - *Environmental Science & Technology* **27(8)**: 1517-1523. [RLL# 166]
AIR POLLUTION/ CHLORINATED HYDROCARBONS/ ORGANOCHLORINE
4 fig. 5 tab. [Includes the lichen Parmelia sulcata.]

• Muir, DCG/ Segstro, MD/ Welbourn, PM/ Toom, D/ Eisenreich, SJ/ Macdonald, CR/ Whelpdale, DM 1993: Patterns of accumulation of airborne organochlorine contaminants in lichens from the upper Great Lakes region of Ontario. - *Environmental Science & Technology* **27(6)**: 1201-1210. [RLL# 153]
AIR POLLUTION/ BIOMONITORING/ ONTARIO/ ORGANOCHLORINE/ PCB
7 fig. 4 tab.

• Richardson, DHS 1991: Lichens as biological indicators - recent developments. - *In:* Jeffrey, DW/Madden, B (eds.): *Bioindicators and Environmental Management*. . Academic Press, London, San Diego pp. 263-272. [RLL# 159]
ACID RAIN/ AIR POLLUTION/ BIOINDICATION/ METAL POLLUTION/ PCB/ RADIONUCLIDES/ SO2

• Thomas, DJ/ Tracey, B/ Marshall, H/ Norstrom, RJ 1992: Arctic terrestrial ecosystem contamination. - *Science of the Total Environment* **122**: 135-164. [RLL# 169]
ARCTIC/ DDT/ FALLOUT/ PCB/ POLLUTION/ RADIOACTIVE NUCLIDES
5 fig. 8 tab. [Review article, including some data on lichens.]

• Villeneuve, JP/ Fogelqvist, E/ Cattini, C 1988: Lichens as bioindicators for atmospheric pollution by chlorinated hydrocarbons. - *Chemosphere* **17(2)**: 399-403. [RLL# 140]
FRANCE/ CHLORINATED HYDROCARBONS/ AIR POLLUTION
2 tables. [Lichen samples from southern France are compared to previous reports from Antarctica, Norway, Italy and Sweden. "Lichens are suggested as suitable bioindicators for the study of atmospheric pollution by chlorinated hydrocarbons."]

• Villeneuve, JP/ Holm, E 1984: Atmospheric background of chlorinated hydrocarbons studied in Swedish lichens. - *Chemosphere* **13**: 1133-1138. [RLL# 124-105]
PCB/ CLADONIA/ SWEDEN/ HYDROCARBONS
1 table. 3 figures. [Study on Cladonia alpestris from northern Sweden showed " ... a delay of 2-3 years between the production of PCB's and the deposition of these compounds in the lichen. They confirm the low solubility of PCB's in water and the predominance of atmospheric transport of these chlorinated compounds far away from industrialized areas."]

Recent Literature on Lichens and Mattick's Card Index

RADIONUCLIDES

Search criteria (word match - sorted on author):
Data set(s): RLL + Mattick + Supplement
Text string in title, keywords, or abstract: radionuclides
Period: 1875 - 2001

• Åhman, B 1990: Transfer of radiocaesium from lichen to reindeer. - *Rangifer* **1990((special issue 4))**: 67-68. [RLL# 166]
CESIUM/ CHERNOBYL/ RADIOCESIUM/ RADIONUCLIDES/ REINDEER/ SWEDEN
1 fig. 1 tab.

• Åhman, B/ Forberg, S/ Åhman, G 1990: Zeolite and bentonite as caesium binders in reindeer feed. - *Rangifer* **1990(Spec. Iss. 3)**: 73-82. [RLL# 166]
CESIUM/ CESIUM 137/ CHERNOBYL/ NORWAY/ RADIATION/ RADIONUCLIDES/ REINDEER
5 fig. 3 tab.

• Adamo, P/ Violante, P/ Violante, A 1989: Contenuto di radionuclidi nel tallo di Stereocaulon vesuvianum (Pers.). [radionuclides content in Stereocaulon vesuvianum (Pers.) thallus]. - *S.IT.E. Atti* **7**: 173-176. [RLL#]

BIOINDICATORS/ POLLUTION/ RADIATION/ RADIONUCLIDES
5 tab.

- Adamova, LI/ Biazrov, LG 1991: Heavy natural radionuclides in lichen from different ecosystems of the West Caucasus. - *In:* Krivolutzkij, DA (ed.): *Bioindication and Biomonitoring*. . Nauka Press, Moscow pp. 125-129. [RLL# 150]
AIR POLLUTION/ BIOINDICATION/ CAUCASUS/ RUSSIA
2 tab.

- Akçay, H 1995: Deposition of fission product radionuclides in lichens and coniferous plants in Turkey. - *Journal of Radioanalytical and Nuclear Chemistry, Letters* **200(2)**: 147-158. [RLL# 162]
CHERNOBYL/ FALLOUT/ RADIOACTIVITY/ RADIONUCLIDES/ TURKEY
3 fig. 5 tab. [Study of Chernobyl fallout radionuclides in the lichens and pines in northern and western Turkey.]

- Akçay, H/ Ardisson, G 1988: Radioactive pollution of Turkish biotas one year after the Chernobyl accident. - *Journal of Radioanalytical and Nuclear Chemistry, Letters* **128(4)**: 273-281. [RLL# 169]
CHERNOBYL/ RADIONUCLIDES/ TURKEY
1 fig. 2 tab.

- Akçay, H/ Kesercioglu, T 1990: A systematic study on the West Anatolia lichens related to the Chernobyl fallout [Bati Anadolu likenleri üzerinde Çernobil serpintisi ile ilgili sistematik bir çalisma]. - *Doga - Turkish Journal of Engineering and Environmental Sciences* **14**: 28-38. [RLL# 169]
CHERNOBYL/ RADIONUCLIDES/ TURKEY
4 fig. 2 tab.

- Barci-Funel, G/ Dalmasso, J/ Barci, VL/ Ardisson, G 1995: Study of the transfer of radionuclides in trees at a forest site. - *Science of the Total Environment* **173/174**: 369-373. [RLL# 166]
CESIUM/ CHERNOBYL/ RADIOACTIVITY/ RADIONUCLIDES/ STRONTIUM
2 tab. [Lichen and moss were among the materials analyzed for background levels.]

- Beasley, TM/ Palmer, HE 1966: Lead-210 and polonium-210 in biological samples from Alaska. - *Science* **152**: 1062-1064. [RLL# 65]
LEAD/ RADIONUCLIDES/ ALASKA/ POLONIUM/ FALLOUT
3 tab. [The analysis of a "composite sample" of lichens is included in this report.]

- Biazrov, L 1993: Lichens as indicators of radioactive contamination. - *Journal of Radioecology* **1**: 15-20. [RLL# 156]
ACCUMULATION/ CHERNOBYL/ RADIOACTIVITY/ RADIONUCLIDES
4 tab. [Study of radionuclide accumulation by lichen thalli at Chernobyl and at Kyshtym in the eastern Urals.]

- Biazrov, LG 1994: Radionuclide content in lichen thallus in the forest adjacent to the Chernobyl atomic power plant. - *Science of the Total Environment* **157**: 25-28. [RLL# 158]
CHERNOBYL/ NUCLEAR POWER/ POLLUTION/ RADIATION/ RADIONUCLIDES
1 tab.

- Biazrov, LG 1994: The radionuclides in lichen thalli in Chernobyl and East Urals areas after nuclear accidents [Radionuklide in Flechtenlagern aus den Gebieten um Tschernobyl und des Ost-Urals nack Kernunglücken]. - *Phyton [Austria]* **34(1)**: 85-94. [RLL# 158]
CHERNOBYL/ NUCLEAR POWER/ POLLUTION/ RADIATION/ RADIONUCLIDES
4 tab.

- Biazrov, LG 1996: The radionuclides in lichens of area of plant for remaking and conservation of low-radioactive waste products. - *In:* Amiro, B/Avadhanula, R/Johansson, G/Larsson, C-M/Lüning, M (eds.): *Proceedings 2. International Symposium on Ionising Radiation, Stockholm, May 20-24, 1996*. . pp. 542-545. [RLL# 167]
MOSCOW/ RADIOACTIVITY/ RADIONUCLIDES/ RUSSIA
1 tab. [Study around a nuclear waste re-processing plant 75 km from Moscow.]

- Birke, L-C/ Pedersen, O/ Hove, K/ Staaland, H 1995: Effect of sodium and potassium supplementation on accumulation and excretion of radiocaesium in reindeer. - *Rangifer* **15(2)**: 71-77. [RLL# 163]

CHERNOBYL/ RADIOACTIVITY/ RADIOCESIUM/ RADIONUCLIDES/ REINDEER
2 fig. 6 tab.

- Blanchard, RL/ Moore, JB 1970: 210Pb and 210Po in tissues of some Alaskan residents as related to consumption of caribou or reindeer meat. - *Health Phys.* **18**: 127-134. [RLL# 76]
CARIBOU/ REINDEER/ FALLOUT/ ALASKA/ FOOD/ LEAD/ POLONIUM/ RADIONUCLIDES/ ISOTOPES
5 tab. ["Concentrations of 210Pb and 226Ra in Alaskan lichen samples collected before 1951 were comparable to concentrations in similar samples collected recently."]

- Book, SA/ Connolly, GE/ Longhurst, WM 1972: Fallout 137Cs accumulation in two adjacent populations of northern California deer. - *Health Physics* **22**: 379-385. [RLL# 89]
137CS / DEER / CALIFORNIA / USA / RADIONUCLIDES/ ISOTOPES / CESIUM / FALLOUT
["....lichens contained up to 140 times the 137Cs activity of other forage."]

- Chant, LA/ Andrews, HR/ Cornett, RJ/ Koslowsky, V/ Milton, JCD/ Van Den Berg, GJ/ Verburg, TG/ Wolterbeek, HT 1996: ^{129}I and ^{36}Cl concentrations in lichens collected in 1990 from three regions around Chernobyl. - *Applied Radiation and Isotopes* **47(9/10)**: 933-937. [RLL# 168]
CHERNOBYL/ CHLORINE/ IODINE/ MASS SPECTROMETRY/ RADIONUCLIDES
4 fig. 3 tab.

- Chibowski, S/ Solecki, J/ Bystrek, J 1998: The examination of gamma-emitter contamination level of the lichens from eastern and south-eastern Poland, collected in the years 1949-1996. - *Journal of Radioanalytical and Nuclear Chemistry* **230(1-2)**: 319-322. [RLL# 171]
CESIUM 137/ ISOTOPES/ POLAND/ RADIOACTIVE NUCLIDES/ RADIONUCLIDES
1 fig. 1 tab.

- Eckl, P/ Hofmann, W/ Turk, R 1986: Uptake of natural and man-made radionuclides by lichens and mushrooms. - *Radiation and Environmental Biophysics* **25**: 43-54. [RLL# 130]
RADIONUCLIDES/ UPTAKE/ 137CS/ 60CO/ NUTRITION/ AUSTRIA/ EUROPE/ FALLOUT
4 tables. 2 figures. ["The 137Cs-content of lichens is probably due to absorption by the mycobiont and seems to be used to satisfy their potassium-requirements." Study materials were obtained in the Salzburg Province, Austria. Ten radionuclides were analyzed in 14 species of lichens.]

- Eckl, P/ Turk, R/ Hofmann, W 1984: Natural and man-made radionuclide concentrations in lichens at several locations in Austria. - *Nordic Journal of Botany* **4**: 521-524. [RLL# 123-24]
RADIONUCLIDE/ POLLUTION/ AUSTRIA
4 tables. 1 figure. ["No statistically significant difference was found between samples of the Gastein-valley, Waldviertel, Salzburg, Grossarl and Dachstein concerning the content of natural radionuclides."]

- Eikelmann, IMH/ Bye, K/ Sletten, HD 1990: Seasonal variation of cesium 134 and cesium 137 in semidomestic reindeer in Norway after the Chernobyl accident. - *Rangifer* **1990(Spec. Issue 3)**: 35-38. [RLL# 166]
CESIUM/ CHERNOBYL/ NORWAY/ RADIATION/ RADIONUCLIDES/ REINDEER
3 fig.

- Elkin, BT/ Bethke, RW 1995: Environmental contaminants in caribou in the Northwest Territories, Canada. - *Science of the Total Environment* **160/161**: 307-321. [RLL# 163]
AIR POLLUTION/ CANADA/ CARIBOU/ NORTHWEST TERRITORIES/ ORGANOCHLORINE/ POLYCHLORINATED BIPHENYLS/ RADIONUCLIDES/ RANGIFER
7 fig. 4 tab.

- Ellis, KM/ Smith, JN 1987: Dynamic model for radionuclide uptake in lichen. - *Journal of Environmental Radioactivity* **5(3)**: 185-208. [RLL# 140]
RADIONUCLIDES/ AIR POLLUTION/ TECHNIQUES/ CLADINA/ FALLOUT/ CANADA/ NEW BRUNSWICK
3 tables. 10 figures. [Study area was near the Bay of Fundy, New Brunswick, Canada, and used samples of Cladonia rangiferina to analyze products from a Chinese nuclear test conducted in October, 1980. "A lichen model has been developed to predict lichen inventories of radioactivity for different lichen growth functions and bio-elimination rates. Assuming that lichen growth results in a linear increase in surface area with time, the experimental results yield biological residence times of

1-2 years for 210Pb and Pu and 5-8 years for 137Cs."]

- Erbisch, FH 1974: Lichens of the Enterprise Radiation Forest. - *In:* T. D. Rudolph (ed.): *The Enterprise, Wisconsin, Radiation Forest. Preirradiation Ecological Studies*. . TID-26113, Technical Information Center, Office of Information Services, United States Atomic Energy Commission, Washington pp. 47-53. [RLL# 91-31]
RADIATION/ RADIONUCLIDES/ ISOTOPES/ WISCONSIN/ PARMELIA
10 fig. 2 tab.

- Erbisch, FH 1978: Effect of chronic gamma radiation on Parmelia subaurifera in the Enterprise Radiation Forest. - *The Bryologist* **81**: 137-143. [RLL# 100]
PARMELIA/ WISCONSIN/ RADIATION/ RADIONUCLIDES/ ECOLOGY/ GROWTH/ GAMMA RADIATION
8 figures. 2 tables.

- Erbisch, FH/ Kalosis, JJ 1973: Initial observations of the effects of gamma radiation on oxygen consumption, P-32 uptake and phycobiont of Cladonia sylvatica (L.) Hoffm.. - *Radiation Bot.* **13**: 361-367. [RLL# 90]
CLADONIA SYLVATICA / GAMMA RADIATION / RADIONUCLIDES / CLADINA / ISOTOPES

- Erbisch, FH/ Ligon, JB/ Mathena, DE 1977: Measurement of tensile strength of Cladonia podetia. - *The Bryologist* **80**: 524-527. [RLL# 99]
TENSILE STRENGTH/ CLADONIA/ PODETIA/ GAMMA RADIATION/ RADIONUCLIDES
4 figures. 1 table. [Gamma-irradiated thalli are weaker than controls.]

- Eriksson, O 1990: 137Cs in reindeer forage plants 1986-1988. - *Rangifer* **1990(Spec. Iss. 3)**: 11-14. [RLL# 166]
CESIUM/ CESIUM 137/ CHERNOBYL/ NORWAY/ RADIATION/ RADIONUCLIDES/ REINDEER
4 fig.

- Fahselt, D/ Wu, T-W/ Mott, B 1995: Trace element patterns in lichens following uranium mine closures. - *The Bryologist* **98(2)**: 228-234. [RLL# 159]
CLADINA/ ELEMENT ANALYSIS/ ELEMENT COMPOSITION/ RADIONUCLIDES/ URANIUM
4 fig. 3 tab. ["Instrumental neutron activation analysis was used to determine trace elements in Cladina mitis (Sandst.) Hale & Culb. along transects extending from uranium mines at Elliot Lake and Agnew Lake in central Ontario, Canada."]

- Feige, GB/ Niemann, L/ Jahnke, S 1990: Lichens and mosses--silent chronists of the Chernobyl accident. - *In:* H. M. Jahns (ed.): *Contributions to Lichenology in Honour of A. Henssen*. . Bibliotheca Lichenologica. No. 38. J. Cramer, Berlin-Stuttgart pp. 63-77. [RLL# 141]
CHERNOBYL/ RADIONUCLIDES/ ISOTOPES/ FALLOUT
1 table. ["As shown for the 'Chernobyl-nuclides, ' over long periods lower plants ensure reliable data for detailed reconstructions of deposition and fallout distribution."]

- Gaare, E 1990: Lichen content of radiocesium after the Chernobyl accident in mountains in southern Norway. - *In:* Desmet, G/Nassimbeni, P/Belli, M (eds.): *Transfer of Radionuclides in Natural and Semi-natural Environments*. . Elsevier Applied Science, London, New York pp. 492-501. [RLL# 166]
CHERNOBYL/ NORWAY/ RADIOCESIUM/ RADIONUCLIDES/ REINDEER
1 tab.

- Galun, M/ Ronen, R 1988: Interactions of lichens and pollutants. - *In:* M. Galun (ed.): *CRC Handbook of Lichenology. Volume III*. . CRC Press, Inc., Boca Raton pp. 55-72. [RLL# 138]
AIR POLLUTION/ POLLUTANTS/ PHYSIOLOGY/ MAPPING/ UPTAKE/ HEAVY METALS
5 tables. 3 figures. [Review of lichen interactions with pollutants including SO2, heavy metals, radionuclides, and others. Discussion includes notes on ecosystem alteration and mapping, transplants, morphological and cytological changes, and metabolic and physiological effects. Bibliography contains 107 references.]

- Gannutz, TP 1970: A study of the lichens of an irradiated rain forest. - *In:* H. T. Odum & R. F. Pigeon (eds.): *A Tropical Rain Forest. A Study of Irradiation and Ecology at El Verde, Puerto Rico*. . Division of Technical Information, U.S. Atomic Energy Commission, Oak Ridge pp. D227-D231. [RLL# 82]
RAINFORESTS/ IONIZING RADIATION/ RADIONUCLIDES/ CRUSTOSE/ ADAPTATIONS/ RESISTANCE/ PUERTO

RICO
2 fig. 2 tab. ["None of the lichens survived a total dose in excess of 1x10-6 r; however, a total dose of 3.1 x 10-5 was required to produce a 50% reduction in the numbers of thalli as compared to the controls. This supports the thesis that the crustose type lichens are more resistant to radiation than other forms of lichens."]

- Gannutz, TP 1972: Effects of gamma radiation on lichens--I. Acute gamma radiation on lichen algae and fungi. - *Radiation Bot.* **12**: 331-338. [RLL# 86]
GAMMA RADIATION/ RADIONUCLIDES/ GROWTH EFFECTS
3 fig. 4 tab.

- Garner, JA/ Jenkins, JH 1991: High radiocesium levels in granite outcrop vegetation and reductions through time. - *Health Physics* **60(4)**: 533-538. [RLL# 166]
GEORGIA/ GRANITE OUTCROPS/ RADIOCESIUM/ RADIONUCLIDES
3 fig. 1 tab. [Comparison of radiocesium levels in lichens and other vegetation from granite outcrops with those in a nearby forest area.]

- Gorham, E 1959: A comparison of lower and higher plants as accumulators of radioactive fall-out. - *Canad. Jour. Bot.* **37(2)**: 327-329. [RLL# 44]
FALLOUT/ RADIOACTIVITY/ RADIONUCLIDES/ ANGIOSPERMS
1 fig. 1 tab. [Lichens and mosses accumulate more radioactive fallout than angiosperms.]

- Grass, F/ Bichler, M/ Dorner, J/ Holzner, H/ Ritschel, A/ Ramadan, A/ Westphal, GP/ Gwozdz, R 1994: Application of short-lived radionuclides in neutron activation analysis of biological and environmental samples. - *Biological Trace Element Research* **43(5)**: 33-46. [RLL# 163]
AIR POLLUTION/ ELEMENT ANALYSIS/ NEUTRON ACTIVATION ANALYSIS/ RADIONUCLIDES
8 fig. 3 tab. [Includes a few lichen data.]

- Grodzinsky, DM 1959: On the natural radioactivity of mosses and lichens. - *Ukrain. Bot. Zhurn.* **16(2)**: 30-38. [RLL# 55]
RADIOACTIVITY/ RADIONUCLIDES/ ISOTOPES
6 tab. [16 mosses, 18 lichens. In Ukrainian; English and Russian summaries.]

- Grodzinsky, DM 1960: Natural radioactivity in plants of the Ukrainian SSR. - *Ukrain. Bot. Zhurn.* **17(6)**: 3-14. [RLL# 51]
RADIOACTIVITY/ UKRAINE/ RADIONUCLIDES
5 tab. [18 lichens, tab. 5. In Ukrainian; English and Russian summaries.]

- Guillitte, O 1990: radionuclides fallout on lichens and mosses and their leaching by rain in a forest ecosystem. - *In:* Desmet, G/Nassimbeni, P/Belli, M (eds.): *Transfer of Radionuclides in Natural and Semi-natural Environments*. . Elsevier Applied Science, London, New York pp. 110-117. [RLL# 166]
FALLOUT/ FOREST/ RADIOCESIUM/ RADIONUCLIDES
4 fig.

- Guillitte, O/ Melin, J/ Wallberg, L 1994: Biological pathways of radionuclides originating from the Chernobyl fallout in a boreal forest ecosystem. - *Science of the Total Environment* **157**: 207-215. [RLL# 163]
BOREAL FOREST/ CHERNOBYL/ RADIOCESIUM/ RADIONUCLIDES/ SWEDEN
1 fig. 7 tab.

- Handley, R/ Overstreet, R 1968: Uptake of carrier-free 137Cs by Ramalina reticulata. - *Plant Physiol.* **43**: 1401-1405. [RLL# 69]
137CS/ CESIUM/ FALLOUT/ RAMALINA MENZIESII/ UPTAKE/ PHYSIOLOGY/ RADIONUCLIDES
5 fig. 4 tab. ["The uptake of carrier-free 137Cs ... does not appear to be directly linked to metabolism."]

- Hanen, E/ Miettinen, JK 1966: Gamma emitting radionuclides in subarctic vegetation during 1962-1964. - *Nature* **212**: 379-382. [RLL# 62]
RADIONUCLIDES/ CESIUM/ 137CS/ FINLAND/ SUBARCTIC/ FALLOUT
2 fig. 8 tab. [Cesium-137 in 3 lichens and 1 moss in Finland in 1962.]

• Hanson, WC 1966: Fallout radionuclides in Alaskan food chains. - *Amer. Jour. Veterinary Res.* **27**: 359-366. [RLL# 100]
RADIONUCLIDES/ ISOTOPES/ FALLOUT/ ALASKA
4 figures. 2 tables. [Includes lichens.]

• Hanson, WC 1967: Cesium-137 in Alaskan lichens, caribou and eskimos. - *Health Phys.* **13**: 383-389. [RLL# 71]
CESIUM/ 137CS/ FALLOUT/ FOOD CHAIN/ CARIBOU/ ALASKA/ ESKIMOS/ RADIONUCLIDES
4 fig.

• Hanson, WC 1967: Radioecological concentration processes characterizing arctic ecosystems. - *In:* B. Aberg & F. P. Hungate (eds.): *Radioecological Concentration Processes*. . Pergamon Press, Oxford pp. 183-191. [RLL# 72]
RADIONUCLIDES/ STRONTIUM/ CESIUM/ ISOTOPES/ FALLOUT/ ALASKA
4 fig. 1 tab. [Includes data on 90Sr and 137Cs in lichens in Alaska.]

• Hanson, WC 1971: Fallout radionuclide distribution in lichen communities near Thule. - *Arctic* **24**: 269-276. [RLL# 83]
FALLOUT/ ARCTIC/ GREENLAND/ RADIONUCLIDES/ ISOTOPES/ COMMUNITY ECOLOGY
4 tab. 1 fig.

• Hanson, WC 1972: Plutonium in lichen communities of the Thule, Greenland region during the summer of 1968. - *Health Phys.* **22**: 39-42. [RLL# 82]
PLUTONIUM/ THULE/ GREENLAND/ RADIONUCLIDES/ FALLOUT/ ISOTOPES
1 fig. 1 tab.

• Hanson, WC/ Watson, DG/ Perkins, RW 1967: Concentration and retention of fallout radionuclides in Alaskan arctic ecosystems. - *In:* B. Aberg & F. P. Hungate (eds.): *Radioecological Concentration Processes*. . Pergamon Press, Oxford pp. 233-245. [RLL# 72]
RADIONUCLIDES/ STRONTIUM/ CESIUM/ ISOTOPES/ FALLOUT/ ALASKA
11 tab. [Includes data on 8 lichens.]

• Hasanen, E/ Miettinen, JK 1966: Gamma emitting radionuclides in subarctic vegetation during 1962-64. - *Nature* **212**: 379-382. [RLL# 75]
RADIONUCLIDES/ CESIUM/ ISOTOPES/ FALLOUT/ FINLAND
2 fig. 8 tab. [Cesium-137 in 3 lichens and 1 moss in Finland in 1962. Reported in List 62 but with a typographical error.]

• Heinrich, G/ Müller, H/ Oswald, K/ Wolkinger, F 1989: Natürliche und Tschernobyl-verursachte Radionuklide in einigen Wasser- und Landpflanzen in Steiermark und Kärnten. - *Phyton [Austria]* **29(1)**: 61-68. [RLL#]
CHERNOBYL RADIATION/ RADIONUCLIDES
2 tab.

• Heinrich, G/ Müller, HJ/ Oswald, K/ Gries, A 1989: Natural and artificial radionuclides in selected Styrian soils and plants before and after the reactor accident in Chernobyl. - *Biochemie und Physiologie der Pflanzen* **185**: 55-67. [RLL# 176]
AUSTRIA/ CHERNOBYL/ RADIOACTIVITY/ RADIONUCLIDES/ SOIL
1 fig. 8 tab.

• Hoffmann, GR 1972: The accumulation of cesium-137 by cryptogams in a Liriodendron tulipifera forest. - *Bot. Gaz.* **133**: 107-119. [RLL# 84]
CESIUM/ 137CS/ FALLOUT/ RADIONUCLIDES/ TENNESSEE/ ISOTOPES
6 tab. 9 fig. [14 lichens; detailed analysis in Tennessee.]

• Holleman, DF/ Luick, JR/ Whickler, FW 1971: Transfer of radiocesium from lichen to reindeer. - *Health Phys.* **21**: 657-666. [RLL# 81]
RADIOCESIUM/ CESIUM/ RADIONUCLIDES/ FALLOUT/ REINDEER/ FOOD CHAIN
4 fig. 5 tab.

• Holm, E/ Persson, RBR 1977: Radiochemical studies of 241Pu in Swedish reindeer lichen. - *Health Phys.* **33**: 471-473. [RLL# 100]
RADIONUCLIDES/ PU/ SWEDEN/ ISOTOPES/ RADIOCHEMISTRY
2 figures. 1 table.

• Holtzman, RB 1966: Natural levels of lead-210, polonium-210 and radium-226 in humans and biota of the Arctic. - *Nature* **210**: 1094-1097. [RLL# 62]
RADIONUCLIDES/ ARCTIC/ RADIOISOTOPES/ FINLAND/ ALASKA/ NEW HAMPSHIRE/ LEAD/ POLONIUM/ RADIUM
2 tab.

• Hutchinson-Benson, E/ Svoboda, J/ Taylor, HW 1985: The latitudinal inventory of 137Cs in vegetation in topsoil in northern Canada, 1980. - *Canadian Journal of Botany* **63**: 784-791. [RLL# 126-49]
CAESIUM/ ISOTOPE/ RADIONUCLIDE/ CANADA/ MANITOBA/ FALLOUT/ ELLESMERE ISLAND/ SOIL
2 tables. 6 figures. [137Cs content was measured and is reported for several lichens in Manitoba and Ellesmere Island. Maximum accumulation was between 60 and 70 N.]

• Jaworowski, Z 1966: Temporal and geographical distribution of radium D (lead-210). - *Nature* **212**: 886-889. [RLL# 82]
RADIUM/ LEAD/ ISOTOPES/ RADIONUCLIDES/ HUMAN BONES
2 fig. 3 tab. [Concerns concentrations of radium D in lichens and human bones.]

• Jeran, Z/ Byrne, AR/ Batic, F 1995: Transplanted epiphytic lichens as biomonitors of air-contamination by natural radionuclides around the Zirovski vrh uranium mine, Slovenia. - *Lichenologist* **27(5)**: 373-385. [RLL# 160]
BIOMONITORING/ LEAD/ MINE SPOILS/ RADIATION/ RADIONUCLIDES/ RADIUM/ TRANSPLANTS/ URANIUM
5 fig. 3 tab. [Transplanted Hypogymnia physodes is used to study accumulation of long-lived radionuclides, 238U, 226Ra, and 210Pb.]

• Jeran, Z/ Jacimovic, R/ Batic, F/ Prosenc, A 1996: Natural and artificial radionuclides in lichens as air pollution monitors. - *In:* Glavic-Cindro, D (ed.): *Proceedings, Radiation Protection in Neighbouring Countries in Central Europe - 1995 (Portoroz, Slovenia, Sept. 4-8, 1995)*. . Ljubljana pp. 259-261. [RLL# 164]
AIR POLLUTION/ RADIATION/ RADIONUCLIDES/ SLOVENIA
1 fig. 1 tab.

• Jones, JM/ Platt, RB 1969: Effects of ionizing radiation, climate, and nutrition on gorwth and structure of a lichen Parmelia conspersa (Ach.) Ach.. - *In:* D. L. Nelson & F. C. Evans (eds.): *Symposium on Radioecology*. . Second National Symposium, Ann Arbor, Michigan, May 15-17, 1967 pp. 111-119. [RLL# 82]
IONIZING RADIATION/ ISOTOPES/ PARMELIA/ XANTHOPARMELIA/ RADIONUCLIDES
5 fig. 1 tab.

• Köse, A/ Topcuoglu, S/ Varinlioglu, A/ Kopya, A/ Azar, A/ Uzun, O/ Karal, H 1994: The levels of cesium radionuclides in lichens in the eastern Black Sea area of Turkey. - *Toxicological and Environmental Chemistry* **45**: 221-224. [RLL# 166]
CESIUM/ CHERNOBYL/ RADIOACTIVITY/ RADIOCESIUM/ TURKEY
1 fig. 1 tab.

• Kauranen, P/ Miettinen, JK 1967: 210Po and 210Pb in environmental samples in Finland. - *In:* B. Aberg & F. P. Hungate (eds.): *Radioecological Concentration Processes*. . Pergamon Press, London pp. 275-280. [RLL# 95]
RADIONUCLIDES/ FINLAND/ EUROPE/ CONCENTRATION PROCESSES/ AIR POLLUTION

• Kauranen, P/ Miettinen, JK 1969: 210Po and 210Pb in the arctic food chain and the natural radiation exposure of Lapps. - *Health Phys.* **16**: 287-295. [RLL# 78]
ARCTIC/ FOOD CHAINS/ LAPPS/ LAPPLAND/ SCANDINAVIA/ FALLOUT/ POLONIUM/ LEAD/ RADIONUCLIDES/ ISOTOPES/ REINDEER
9 tab. ["... the arctic food chain, lichen-reindeer-man, maintains a high 210Po concentration in soft tissues of reindeer breeding Lapps."]

• Kauranen, P/ Miettinen, JM 1969: 210Po and 210Pb in the arctic food chain and the natural radiation exposure of Lapps. - *Health Phys.* **16**: 287-295. [RLL# 82]
POLONIUM/ LEAD/ ISOTOPES/ RADIONUCLIDES/ LAPPS/ SCANDINAVIA/ FOOD CHAIN
9 tab.

• Kondratyuk, SY/ Navrots'ka, IL/ Brun, GO/ Beznis, NG/ Gizbullina, VK/ Izotova, NV/ Lyugin, VO 1994: Study of the accumulation of radionuclides by lichens of Ukraine. - *Ukrayins'kyi Botanichnyi Zhurnal* **51**: 46-52. [RLL# 169]

RADIOACTIVITY/ RADIONUCLIDES/ UKRAINE
3 fig.

- Kondratyuk, SY/ Navrotskaya, IL/ Brun, GA/ Lyugin, VO 1993: Content of radionuclides in the lichens of Ukrainian Polessie (1990-1991). - *Ukrayins'kyi Botanichnyi Zhurnal* **50(3)**: 13-22. [RLL# 156]
RADIATION/ RADIONUCLIDES/ UKRAINE
1 fig. 5 tab. [Eight radionuclides were studied in eleven species, mostly Cladoniae or Cladinae. In Russian, with English abstract.]

- Kreuzer, W/ Schauer, T 1972: The vertical distribution of 137Cs in Cladonia rangiferina and C. silvatica. - *Svensk Bot. Tidskr.* **66**: 226-238. [RLL# 89]
CLADONIA RANGIFERNA / CLADINA SILVATICA/ 137CS/ RADIOACTIVITY / RADIONUCLIDES/ ISOTOPES/ CESIUM

- Larsson, JE 1970: 137Cs in lichen communities on the Baltic coast. - *Svensk Bot. Tidskr.* **64**: 173-178. [RLL# 89]
137CS / BALTIC COAST / EUROPE / RADIONUCLIDES/ ISOTOPES / FALLOUT / CESIUM

- Liden, K/ Gustafsson, M 1967: Relationships and seasonal variation of 137Cs in lichen, reindeer and man in northern Sweden 1961-1965. - *In:* B. Aberg & F. P Hungate (eds.): *Radioecological Concentration Processes*. . Pergamon Press, Oxford pp. 193-208. [RLL# 72]
CESIUM/ RADIONUCLIDES/ ISOTOPES/ FALLOUT/ SWEDEN/ REINDEER/ SEASONAL VARIATION
7 fig. 5 tab.

- Livens, FR/ Horrill, AD/ Singleton, DL 1991: Distribution of radiocesium in the soil-plant systems of upland areas of Europe. - *Health Physics* **60(4)**: 539-545. [RLL# 166]
ITALY/ NORWAY/ RADIOCESIUM/ RADIONUCLIDES/ SCOTLAND/ UPLAND FOREST
8 tab. [Includes lichens and bryophytes.]

- Looney, JHH/ Webber, CE/ Nieboer, E/ Stetsko, PI/ Kershaw, KA 1986: Interrelationships between concentrations of 137Cs and various stable elements in three lichen species. - *Health Physics* **50**: 148-152. [RLL# 130]
137CS/ RADIONUCLIDES/ CANADA/ NORTHWEST TERRITORIES/ DACTYLINA/ CETRARIA/ HEAVY METALS
2 figures. 2 tables. [Studies were conducted in the Northwest Territories, Canada, with Cetraria nivalis, C. cucullata, and Dactylina arctica. "It is suggested that C. nivalis in particular and also D. arctica were enriched in particulates of larger relative dimensions whereas C. cucullata was best suited for particle size discrimination."]

- Loppi, S/ Malfatti, A/ Sani, M/ Whitehead, NE 1997: Lichens as biomonitors of geothermal radionuclide pollution. - *Geothermics* **26(4)**: 535-540. [RLL# 170]
BIOMONITORING/ GEOTHERMAL/ POLLUTION/ RADIONUCLIDES/ SPAIN
2 fig. [Study in central Italy using Parmelia caperata.]

- Luick, JR/ Holleman, DF/ White, RG 1971/1972: *Studies on the nutrition and metabolism of reindeer-caribou in Alaska with special interest in nutritional and environmental adaptation*. - 1971/1972 Technical Progress Report on U.S. Atomic Energy Commission Contract AT(45-1)-2229. Institute of Arctic Biology, University of Alaska, College, Alaska. 84 pp. [RLL# 90]
REINDEER/ CARIBOU / ALASKA / 137CS / RADIONUCLIDES / CESIUM / FALLOUT
[137Cs uptake by reindeer from lichens, pp. 8-11.]

- Mahon, DC 1982: Uptake and translocation of naturally-occurring radionuclides of the uranium series. - *Bulletin of Environmental Contamination and Toxicology* **29**: 697-703. [RLL# 119-92]
ALECTORIA/ URANIUM/ RADIONUCLIDES/ BRITISH COLUMBIA/ RADIOACTIVITY/ BRYORIA/ AIR POLLUTION
5 tables. [Study done in central British Columbia with high levels of natural radioactivity included analysis of Bryoria fremontii and Alectoria sarmentosa.]

• Martin, L/ Nifontova, M/ Martin, J 1991: radionuclides variation in macrolichens in Estonia after the Chernobyl accident. - *Proceedings of the Estonian Academy of Sciences, Ecology* **1991(1)**: 42-51. [RLL# 169]
CAUCASUS/ CHERNOBYL/ ESTONIA/ LAKE BAIKAL/ RADIONUCLIDES/ SPITSBERGEN/ URAL MOUNTAINS/ USSR
7 fig. 2 tab.

• Mattsson, LJS 1975: 137Cs in the reindeer lichen Cladonia alpestris: deposition, retention and internal distribution, 1961-1970. - *Health Phys.* **28**: 233-248. [RLL# 92-54]
RADIOISOTOPES/ RADIONUCLIDES/ AIR POLLUTION/ FALLOUT/ CLADONIA/ HEAVY METALS/ CAESIUM/ CS137
9 fig. 3 tab.

• Miettinen, JK 1967: Concentration of 137 Cs and 55Fe through food chains in arctic and subarctic regions. - *In:* B. Aberg & F. P. Hungate (eds.): *Radioecological Concentrations Processes*. . Pergamom Press, London pp. 267-274. [RLL# 95]
RADIONUCLIDES/ ARCTIC/ FOOD CHAINS/ ISOTOPES/ 137CS/ ANIMALS/ ECOLOGY/ POLLUTION/ FALLOUT

• Miettinen, JK 1971: Radioaktiva nuklider i lav, ren och manniska efter karnvapenprov. [Radioactive nuclides in lichen, reindeer, and man after the testing of nuclear weapons.]. - *Kem. Tidskr.* **1971**: 52-54, 57-58, 61. [RLL# 80]
RADIONUCLIDES/ FALLOUT/ NUCLEAR TESTING/ FOOD CHAINS/ REINDEER/ ISOTOPES
5 fig. 6 tab. [Summary article in Swedish; 17 references.]

• Nedic, O/ Stankovic, A/ Stankovic, S 1998: The existence and removal of evaporable ^{137}Cs-containing compound(s) from the extract of lichen Cetraria islandica. - *Chemisty and Ecology* **14**: 143-149. [RLL# 176]
CESIUM/ CHERNOBYL/ EVAPORATION/ RADIONUCLIDES
2 tab.

• Nedic, O/ Stankovic, A/ Stankovic, S 1999: Organic cesium carrier(s) in lichen. - *The Science of the Total Enviornment* **227(2-3)**: 93-100. [RLL# 176]
CESIUM/ CHERNOBYL/ RADIONUCLIDES
4 fig. 1 tab. [Study using Cetraria islandica.]

• Nevstrueva, MA/ Ramzaev, PV/ Moiseer, AA/ Ibatullin, MS/ Teplykh, LA 1967: The nature of 137Cs and 90Sr transport over the lichen-reindeer-man food chain. - *In:* B. Aberg & F. P Hungate (eds.): *Radioecological Concentration Processes*. . Pergamon Press, Oxford pp. 209-215. [RLL# 72]
RADIONUCLIDES/ CESIUM/ STRONTIUM/ FALLOUT/ FOOD CHAINS/ REINDEER/ TRANSPORT
6 tab.

• Nifontova, M 1995: radionuclides in the moss-lichen cover of tundra communities in the Yamal Peninsula. - *Science of the Total Environment* **160/161**: 749-752. [RLL# 162]
BIOMONITORING/ CESIUM/ RADIONUCLIDES/ RUSSIA/ STRONTIUM/ YAMAL PENINSULA
2 tab.

• Nifontova, M 1998: Bioaccumulation of radionuclides in lichens and mosses [Die Bioakkumulation von Radionukliden in Flechten und Moosen]. - *Sauteria* **9**: 323-329. [RLL# 173]
BIOINDICATION/ CAESIUM/ CHERNOBYL/ RADIOACTIVITY/ RADIONUCLIDES/ STRONTIUM
2 tab. [From the IAL3 Symposium, held Sept. 1-7, 1996, in Salzburg, Austria, Poster Contributions.]

• Nifontova, MG 1997: Dynamics of long-lived radionuclides in mosses and lichens. - *Russian Journal of Ecology* **28(4)**: 240-244. [RLL# 170]
CHERNOBYL/ CS137/ RADIOACTIVITY/ RADIONUCLIDES/ RUSSIA/ SR90
2 fig. 1 tab. [Whereas the concentration of ^{90}Sr remained unchanged over a 15 year observation period, the concentration of ^{137}Cs increased 20-40 times after Chernobyl. Translation of an article from Ekologiya, 1997, pp. 273-277.]

• Nifontova, MG 1998: Concentrations of long-lived arificial radionuclides in the moss-lichen cover of terrestrial ecosystems in the Ural-Siberian region. - *Russian Journal of Ecology* **29(3)**: 167-171. [RLL# 173]
CAESIUM/ RADIOACTIVITY/ RADIONUCLIDES/ RUSSIA/ SIBERIA/ STRONTIUM/ URALS

2 fig. 3 tab. [Translation from Ekologiya.]

- Nifontova, MG 2000: Concentrations of long-lived artificial radionuclides in the lichens of mountains ecosystems. - *In:* : *The Fourth IAL Symposium, Progress and Problems in Lichenology at the Turn of the Millennium*. . Universitat de Barcelona, Barcelona pp. 64. [RLL# 181]
CS137/ ECOSYSTEM/ MONTANE/ RADIONUCLIDES/ RUSSIA/ SR90
[Abstract from the International Association for Lichenology's fourth symposium, held in Barcelona, Spain, 3-8 September 2000.]

- Nifontova, MG/ Alexashenko, VN 1993: Content of 90Sr and 134, 137Cs in fungi, lichens, and mosses in the vicinity of the Chernobyl nuclear power plant. - *Soviet Journal of Ecology* **23(3)**: 152-155. [RLL# 155]
CESIUM/ CHERNOBYL/ RADIOACTIVITY/ RADIONUCLIDES/ STRONTIUM
1 fig. 1 tab.

- Nifontova, MG/ Kulikov, NV/ Ravinskaya, AP 1989: Effect of gamma-radiation on accumulation of 90Sr and 137Cs by lichens. - *Soviet Journal of Ecology* **20(6)**: 355-360. [RLL# 143]
CAESIUM/ STRONTIUM/ 137CS/ 90SR/ RADIONUCLIDES/ GAMMA RADIATION/ FALLOUT
2 figures. 4 tables. ["It is demonstrated that gamma irradiation of lichens in doses of from 50 to 50, 000 Gy has little effect on subsequent physiochemical processes underlying fixation of 90Sr by thalli. On the other hand, accumulation of 137Cs by the plants declines to a significant extent because high doses of gamma irradiation lead to destruction of the algal symbiont of lichens." Translation of original article appearing in Ekologiya 1989: 44-50.]

- Nifontova, MG/ Lebedeva, AV/ Kulikov, NV 1979: Accumulation of 90Sr and 137Cs in live and dead lichens. - *Soviet Journal of Ecology* **10**: 73-78. [RLL# 105-62]
STRONTIUM/ CESIUM/ CLADONIA/ ISOTOPE/ RADIONUCLIDES/ UMBILICARIA/ PELTIGERA
4 figures. 1 table. [Using Cladonia amaurocraea, Umbilicaria pensylvanica and Peltigera canina the authors show "...that the mechanisms of 90Sr absorption by lichens from water solutions are primarily based on physiochemical sorption whereas a greater role is played by physio-biochemical processes related to metabolic plant activity in the absorption of 137Cs. In this case, both radionuclides are retained in lichens in a relatively mobile ion-exchange form." Translation by Consultants Bureau, New York. Original article published in Ekologiya 10(1): 94-97.]

- Ninfontova, MG 1976: Accumulation of Sr90 and Cs137 by lichens under experimental conditions. - *Soviet Jour. Ecol.* **7**: 68-70. [RLL# 100]
CS137/ SR90/ RADIONUCLIDES/ ISOTOPES/ FALLOUT/ ACCUMULATION
3 figures. [Plenum Publishing Corporation's translation. Original reference: Ekologiya 7: 89-92. 1976 (not seen).]

- Ninfontova, MG/ Kulikov, NV 1977: Accumulation of Sr90 and Cs137 by lichens under natural conditions. - *Soviet Jour. Ecol.* **8**: 270-273. [RLL# 100]
CS137/ SR90/ RADIONUCLIDES/ ISOTOPES/ FALLOUT/ ACCUMULATION
3 figures. [Plenum Publishing Corporation's translation. Original reference: Ekologiya 8: 93-96. 1977 (not seen).]

- Palmer, HE/ Beasley, TM 1967: 55Fe in the marine environment and in people who comsume ocean fish. - *In:* B. Aberg & F. P Hungate (eds.): *Radioecological Concentration Processes*. . Pergamon Press, Oxford pp. 259-262. [RLL# 72]
RADIONUCLIDES/ ISOTOPES/ FOOD CHAINS/ IRON/ MARINE
3 tab. ["A concentration process for 55Fe exists in the marine environment which far exceeds the concentration that occurs in the lichen-caribou-Eskimo food chain."]

- Palmer, HE/ Hanson, WC/ Griffin, BI/ Roesch, WC 1963: Cesium-137 in Alaskan eskimos. - *Science* **142(3588)**: 64-66. [RLL# 56]
RADIONUCLIDES/ ISOTOPES/ FALLOUT/ ALASKA/ ESKIMOS/ CESIUM/ CARIBOU/ FOOD
1 tab. [The now famous study in which high body burdens of cesium-137 in eskimos were traced to the consumption of caribou which had eaten lichens which had accumulated high levels of the radioactive material.]

- Persson, B 1967: 55Fe from fallout in lichen, reindeer and Lapps. - *In:* B. Aberg & F. P Hungate (eds.): *Radioecological Concentration Processes*. . Pergamon Press, Oxford pp. 253-258. [RLL# 72]
FALLOUT/ IRON/ ISOTOPES/ REINDEER/ LAPPS/ FOOD CHAIN/ RADIONUCLIDES

1 tab. 5 fig.

- Persson, BR 1970: 210Pb-Atmospheric deposition in lichen-carpets in northern Sweden during 1961-1969. - *Tellus* **22**: 564-571. [RLL# 81]
LEAD/ RADIONUCLIDES/ FALLOUT/ SWEDEN/ 210PB/ ISOTOPES
4 fig. 2 tab.

- Plummer, GL 1969: Fallout radioisotopes in Georgia lichens. - *In:* D. J. Nelson & F. C. Evans (eds.): *Symposium on Radioecology (Second National Symposium, Ann Arbor, Michigan, May 15-17, 1967)*. . pp. 571-577. [RLL# 75]
RADIOECOLOGY/ FALLOUT/ RADIONUCLIDES/ GEORGIA
1 fig. 3 tab. [Study of 3 species.]

- Plummer, GL/ Helseth, F 1965: Movement and distribution of radionuclides on granite outcrops within the Georgia piedmont. - *Health Phys.* **11**: 1423-1428. [RLL# 75]
FALLOUT/ RADIONUCLIDES/ SAXICOLOUS/ GEORGIA/ USA/ DISTRIBUTION/ PARMELIA/ XANTHOPARMELIA
3 tab. [Includes data on Parmelia conspersa.]

- Poliakov, IA/ Leont've, AM/ Mel'nikov, LK 1962: Contribution to Sr90 fallouts in the medium latitudes of the USSR. - *Pochvovedenie* **1962(11)**: 45-50. [RLL# 59]
USSR/ FALLOUT/ STRONTIUM/ SR90/ RADIONUCLIDES/ BIOINDICATION/ HEAVY METALS/ AIR POLLUTION
2 tab. [In Russian. "This paper deals with the role of mosses (Bryophyte) and lichens (Lichenes), as a source of Sr90 accumulation. Biochemical and morphological properties of these plants allow their use as reliable indicators for testing of a given area contamination with Sr90 and other radionuclides." --The entire English summary verbatim.]

- Potter, LD/ Barr, M 1969: Cesium-137 concentrations in Alaskan Arctic tundra vegetation, 1967. - *Arctic Alpine Res.* **1**: 147-153. [RLL# 83]
CESIUM/ 137CS/ FALLOUT/ RADIONUCLIDES/ ISOTOPES/ ALASKA/ TUNDRA
1 fig. 1 tab. [Includes concentrations in lichens.]

- Pullum, PA/ Erbisch, FH 1972: Effects of gamma radiation on the lichen Cladonia verticillata (Hoffm.) Schaer.. - *The Bryologist* **75**: 48-53. [RLL# 82]
GAMMA RADIATION/ RADIOACTIVITY/ RADIONUCLIDES/ CLADONIA
15 fig.

- Richardson, DHS 1991: Lichens as biological indicators - recent developments. - *In:* Jeffrey, DW/Madden, B (eds.): *Bioindicators and Environmental Management*. . Academic Press, London, San Diego pp. 263-272. [RLL# 159]
ACID RAIN/ AIR POLLUTION/ BIOINDICATION/ METAL POLLUTION/ PCB/ RADIONUCLIDES/ SO2

- Rickard, WH/ Davis, JJ/ Hanson, WC/ Watson, DG 1965: Gamma-emitting radionuclides in Alaskan tundra vegetation 1959, 1960, 1961. - *Ecology* **46**: 352-356. [RLL# 67]
RADIONUCLIDES/ FALLOUT/ ALASKA/ CETRARIA/ CLADONIA/ CORNICULARIA/ GAMMA-EMITTING
[Includes analyses of some Cetraria, Cladonia, and Cornicularia species.]

- Roos, P/ Holm, E/ Persson, RBR/ Aarkrog, A/ Nielsen, SP 1994: Deposition of 210Pb, 137Cs, 239+240Pu, 238Pu, and 241Am in the Antarctic Peninsula area. - *Journal of Environmental Radioactivity* **24**: 235-251. [RLL# 166]
ANTARCTIC/ CS137/ LEAD/ PU/ RADIOACTIVITY/ RADIONUCLIDES/ SOUTH SHETLAND ISLANDS
3 fig. 5 tab.

- Saka, AZ/ Cevik, U/ Bacaksiz, E/ Kopya, AI/ Tirasoglu, E 1997: Levels of cesium radionuclides in lichens and mosses from the province of Ordu in the Eastern Black Sea area of Turkey. - *Journal of Radioanalytical and Nuclear Chemistry* **222(1-2)**: 87-92. [RLL# 171]
CESIUM/ CHERNOBYL/ NUCLEAR POWER/ RADIONUCLIDES/ TURKEY
5 fig. 4 tab.

- Sawidis, T/ Heinrich, G/ Chettri, MK 1997: Cesium-137 monitoring using lichens from Macedonia, northern Greece. - *Canadian Journal of Botany* **75(12)**: 2216-2223. [RLL# 171]

CESIUM/ CHERNOBYL/ CS137/ GREECE/ MACEDONIA/ RADIONUCLIDES
2 fig. 5 tab.

- Seaward, MRD 1991: Biomonitoring radionuclides in eastern Europe pre- and post-Chernobyl. - *In:* Ayvaz, Z (ed.): *Proceedings of the 1st Symposium on Environmental Pollution and Control*. 1. Ege University, Izmir, Turkey pp. 80-89. [RLL#]
CHERNOBYL/ POLLUTION/ RADIATION/ RADIONUCLIDES

- Seaward, MRD 1992: *Lichens, silent witnesses of the Chernobyl disaster*. - University of Bradford, Inaugural Lecture, 3 March 1992,. 14 pp. [RLL# 149]
BIOMONITORING/ CHERNOBYL/ RADIONUCLIDES
2 fig. 1 tab.

- Seaward, MRD/ Heslop, JA/ Green, D/ Bylinska, EA 1988: Recent levels of radionuclides in lichens from southwest Poland with particular reference to 134Cs and 137Cs. - *Journal of Environmental Radioactivity* **7**: 123-129. [RLL# 135]
RADIONUCLIDES/ POLAND/ CESIUM/ UMBILICARIA/ CHERNOBYL/ USSR
2 tables. 2 figures. [Recent significant increases in 134Cs and 137Cs have been found in Umbilicaria species when compared to studies in 1978-79. "The composition and ratio of the various radionuclides, particularly in respect of 134Cs and 137Cs, exhibit a characteristic signature consistent with contamination derived from the accident at Chernobyl nuclear reactor in April 1986."]

- Sheard, JW 1986: Distribution of uranium series nuclides in upland vegetation of northern Saskatchewan. I. Plant and soil concentrations. - *Canadian Journal of Botany* **64**: 2446-2452. [RLL# 132]
URANIUM/ ECOLOGY/ AIR POLLUTION/ RADIONUCLIDES/ CANADA/ CLADINA/ SASKATCHEWAN
6 tables. 1 figure. [Three lichen species are included in the analyses. "High levels in the lichen and moss species suggest that the primary source of uranium in these species is not directly from the soil."]

- Sheard, JW 1986: Distribution of uranium series nuclides in upland vegetation of northern Saskatchewan. II. Patterns of accumulation among species and localities. - *Canadian Journal of Botany* **64**: 2453-2463. [RLL# 132]
URANIUM/ ECOLOGY/ AIR POLLUTION/ RADIONUCLIDES/ CANADA/ CLADINA/ SASKATCHEWAN
7 tables. 3 figures. [Cladina species were included in the analyses. The pattern of accumulation in the non-vascular species differed from the vascular plants.]

- Snyder, JM 1973: The effect of chronic gamma irradiation on the growth of a crustose lichen, Trapelia ornata (Sommerfelt) Hertel. - *Radiation Bot.* **13**: 269-271. [RLL# 89]
CRUSTOSE LICHEN / TRAPELIA ORNATA / GAMMA IRRADIATION / GROWTH CONTROL/ RADIOACTIVITY / RADIONUCLIDES

- Staaland, H/ Garmo, TH/ Hove, K/ Pedersen, O 1995: Feed selection and radiocaesium intake by reindeer, sheep and goats grazing alpine summer habitats in southern Norway. - *Journal of Environmental Radioactivity* **29(1)**: 39-56. [RLL# 163]
CHERNOBYL/ FEEDING PREFERENCES/ GOATS/ RADIOACTIVITY/ RADIOCESIUM/ RADIONUCLIDES/ REINDEER/ SHEEP
4 fig. 4 tab.

- Svensson, GK/ Liden, K 1965: The transport of 137Cs from lichen to animal to man. - *Health Phys.* **11**: 1393-1400. [RLL# 67]
CESIUM/ FOOD CHAIN/ RADIONUCLIDES/ GRAZING HABITS/ REINDEER/ FALLOUT/ SWEDEN/ LAPPS/ 137CS
7 fig. 1 tab. ["The grazing habits of the reindeer and the fallout pattern imply that there is a delay of 7-10 months in the transfer of 137Cs from lichen to man" in Lapp communities in Sweden.]

- Taylor, FG/ Witherspoon, JP 1972: Retention of simulated fallout particles by lichens and mosses. - *Health Phys.* **23**: 867-869. [RLL# 84]
FALLOUT/ RADIONUCLIDES/ SIMULATIONS
1 fig. 1 tab.

• Taylor, HW/ Hutchinson, EA/ McInnes, KL/ Svoboda, J 1979: Cosmos 954: search for ariborne radioactivity on lichen in the crash area, Northwest Territories, Canada. - *Science* **205**: 1383-1385. [RLL# 109-101]
CANADA/ RADIONUCLIDES/ ECOLOGY
2 figures. ["The fission product radioactivity detected on lichens in the vicinity of the impact area of the Soviet satellite Cosmos 954 does not exceed that background level found in the general area as a result of past nuclear explosions."]

• Thomas, PA/ Gates, TE 1999: radionuclides in the lichen-caribou-human food chain near uranium mining operations in northern Saskatchewan, Canada. - *Environmental Health Perspectives* **107(7)**: 527-537. [RLL# 179]
CARIBOU/ FOOD CHAINS/ RADIONUCLIDES/ SASKATCHEWAN/ URANIUM/ URANIUM MINING
9 fig. 6 tab.

• Topcuoglu, S/ Van Dawen, AM/ Güngör, N 1995: The natural depuration rate of 137Cs radionuclides in a lichen and moss species. - *Journal of Environmental Radioactivity* **29(2)**: 157-162. [RLL# 163]
CESIUM/ CHERNOBYL/ RADIOACTIVITY/ RADIONUCLIDES/ TURKEY
3 fig. 1 tab. [Study conducted in Turkey, using Xanthoria parietina.]

• Triulzi, C/ Nonnis Marzano, F/ Mori, A/ Casoli, A/ Vaghi, M 1991: Presence of radionuclides in biotic and abiotic matrixes collected in the environment around the Italian base in Antarctica. - *Annali di Chimica* **81**: 549-561. [RLL# 166]
ANTARCTICA/ CESIUM/ POTASSIUM/ RADIONUCLIDES
9 tab.

• Triulzi, C/ Nonnis Marzano, F/ Vaghi, M 1996: Important alpha, beta and gamma-emitting radionuclides in lichens and mosses collected in different world areas. - *Annali di Chimica* **86**: 699-704. [RLL# 168]
ANTARCTICA/ ITALY/ NEPAL/ RADIONUCLIDES/ SCANDINAVIA
3 fig. 1 tab. [Results from Italy, Scandinavia, Nepal and Antarctica.]

• Tuominen, Y 1967: Studies on the strontium uptake of the Cladonia alpestris thallus. - *Ann. Bot. Fenn.* **1**: 1-28. [RLL# 65]
STRONTIUM/ FALLOUT/ CLADONIA ALPESTRIS/ UPTAKE/ RADIONUCLIDES
9 tab. 24 fig. ["From these short-term experiments, it appears that the strontium uptake of Cladonia alpestris is purely a process of physical chemistry without any indications of metabolic activity."]

• Tuominen, Y 1968: Studies on the translocation of caesium and strontium ions in the thallus of Cladonia alpestris. - *Ann. Bot. Fenn.* **5**: 102-111. [RLL# 70]
CLADONIA ALPESTRIS/ TRANSLOCATION/ CESIUM/ STRONTIUM/ PHYSIOLOGY/ FALLOUT/ RADIONUCLIDES
9 fig. 1 tab.

• Tuominen, Y 1971: Studies on some concentration-distance curves of the diffusion of 137Cs and 90Sr ions in columns composed of thallus of Cladonia alpestris. - *Ann. Bot. Fenn.* **8**: 245-253. [RLL# 85]
CESIUM/ STRONTIUM/ 137CS/ 90SR/ FALLOUT/ RADIONUCLIDES/ ISOTOPES/ CLADONIA
6 fig.

• Wasser, SP (ed.) 1995: *Accumulation of radionuclides by Cryptogamic Plants and Higher Fungi of Ukraine*. - National Academy of Sciences of Ukraine, Kiev. 132 pp. [RLL# 167]
CHERNOBYL/ RADIOACTIVITY/ RADIONUCLIDES
20 fig. 23 tab. [In Ukrainian with English abstract.]

• Watson, DG/ Hanson, SC/ Davis, JJ/ Rickard, WH 1966: radionuclides in terrestrial and freshwater biota. - *In:* N. J. Wilimovsky & J. W. Wolfe (eds.): *Environment of the Cape Thompson Region, Alaska*. . U.S. Atomic Energy Commission, Washington pp. 1165-1200. [RLL# 72]

CAPE THOMPSON/ ALASKA/ RADIONUCLIDES/ CETRARIA/ CORNICULARIA/ CLADONIA/ FALLOUT/ ARCTIC TUNDRA
4 fig. 8 tab. [Analysis of "fallout radionuclides in Alaskan vegetation, 1959-1962" (p. 1171) includes data on species of Cetraria, Cladonia, Cornicularia, and Sphagnum. Several other articles in this book made incidental reference to the problem of fallout radionuclides in arctic ecosystems but are not included in the present literature list.]

- Whitkamp, M/ Frank, ML 1967: Retention and loss of cesium-137 by components of the groundcover in a pine (Pinus virginiana L.) stand. - *Health Phys.* **13**: 985-990. [RLL# 73]
CESIUM/ RADIONUCLIDES/ CLADONIA SUBTENUIS/ ISOTOPES
2 fig. 1 tab. [Study of Cladonia subtenuis and Dicranum scoparium.]

- Witkamp, M/ Frank, ML 1967: Retention and loss of cesium-137 by components of the groundcover in a pine (Pinus virginiana L.) stand. - *Health Phys.* **13**: 985-990. [RLL# 77]
PINUS/ CESIUM/ 137CS/ FALLOUT/ CLADONIA SUBTENUIS/ RADIONUCLIDES
2 fig. 1 tab. [Study of Cladonia subtenuis and Dicranum scoparium.]